ADMINISTRATION REPORTS

OF THE

AGRICULTURAL CHEMIST, ENTOMOLOGIST AND MYCOLOGIST

OF THE

DEPARTMENT OF AGRICULTURE, MADRAS, FOR 1937-38

(DETAILED REPORT)

IMPERIAL MYCOLOGICAL
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ADMINISTRATION REPORT OF THE GOVERNMENT AGRICULTURAL CHEMIST FOR THE YEAR 1937-38.

I was in charge of the section throughout the year.

2. The different branches of the section were under the control of gazetted officers as below :—

(i) Analytical and Advisory.—M.R.Ry. T. S. Ramasubrahmanya Ayyar Avargal.

(ii) Physical Chemistry.—M.R.Ry. K. Govindan Nayar Avargal.

(iii) Animal Nutrition.—Government Agricultural Chemist.

(iv) Microbiology.—M.R.Ry. P. D. Karunakar Avargal.

(v) Irrigation Research (at Siruguppa).—M.R.Ry. C. V. Ramaswami Ayyar Avargal.

(vi) Sugarcane and jaggery.—M.R.Ry. G. Ganapathy Ayyar Avargal.

(vii) Malting of cholam.—M.R.Ry. M. Suryanarayana Garu.

3. The work of the section is reported on under two sub-heads. (I) General—including analytical and routine advisory work and (II) Research in Soil Science, Soil Surveys, Plant and Animal Nutrition, Microbiology, and Agricultural Industries.

I. General.

4. *Meteorology.*—Records were maintained of climatological conditions at 8·00 hours. A monthly weather review compiled from reports received from Agricultural Research Stations and from extracts from the Indian Daily Weather Reports published at Poona, was published in the Madras Agricultural Journal.

Table below gives a summary of observations recorded at the Agricultural Research Institute, Coimbatore, for the year 1937-38.

Table I.

Annual weather report, 1937-38.

Month and year.	Temperature. Absolute maximum. (2) oF.	Absolute minimum. (3) oF.	Mean maximum. (4) oF.	Departure from normal. (5) oF.	Mean minimum. (6) oF.	Departure from normal. (7) oF.
1937—						
April ..	98·2	71·0	93·5	— 1·7	73·0	— 0·1
May ..	96·5	70·5	93·7	— 1·1	73·7	— 0·4
June ..	95·0	71·0	89·2	+ 0·6	75·8	+ 2·6
July ..	90·8	68·5	85·3	— 2·0	74·6	+ 2·2
August ..	91·5	68·3	88·7	+ 0·6	71·2	— 0·3
September ..	93·5	66·0	89·5	— 0·2	70·8	+ 0·3
October ..	91·0	65·0	86·9	— 0·2	70·6	— 0·1
November ..	88·0	62·0	82·2	— 2·2	69·0	+ 0·4
December ..	89·0	53·5	85·1	+ 1·1	63·9	— 1·6
1938—						
January ..	91·8	54·5	86·1	+ 0·3	64·1	— 0·1
February ..	94·5	62·5	90·9	+ 0·3	69·0	+ 2·1
March ..	98·0	63·0	95·1	— 0·1	69·9	+ 0·1

Month and year.	Humidity. Humdity at 8 hours. (8) PER CENT.	Departure from normal. (9) PER CENT.	Mean for the month. (10) PER CENT.	Mean daily wind velocity. Velocity of wind for the month. M.P.H. (11)	Mean for the month. M.P.H. (12)
1937—					
April ..	71·5	— 1·1	72·6	1·3	2·1
May ..	72·7	+ 1·1	71·6	1·8	2·9
June ..	68·5	— 0·5	69·0	6·0	6·4
July ..	72·0	+ 1·6	70·4	5·4	7·5
August ..	74·5	+ 0·2	74·3	3·2	5·4
September ..	72·0	— 0·9	72·9	2·3	4·6
October ..	77·4	— 3·5	80·9	1·0	2·3
November ..	81·4	+ 0·6	80·8	0·4	1·7
December ..	74·3	— 4·4	78·7	0·5	2·1
1938—					
January ..	76·5	+ 1·0	75·5	0·9	2·3
February ..	73·9	+ 0·8	73·1	0·7	2·1
March ..	68·6	— 0·6	69·2	1·1	2·3

Month and year.	Rainfall in inches. Rainfall for the month. (13)	Mean for the month. (14)	Departure from normal. (15)	Number of rainy days. (16)
1937—				
April ..	3.73	1·80	+ 1·93	6
May ..	3·93	2·55	+ 1·38	7
June ..	0·24	1·53	— 1·29	2
July ..	1·47	2·10	— 0·63	5
August ..	2·10	1·16	+0·94	4
September ..	0·90	1·83	+ 0·93	2
October ..	3·47	5·79	— 2·32	8
November ..	2·91	4·88	— 1·97	9
December ..	0·14	1·54	— 1·40	1
1938—				
January ..	..	0·73	— 0·73	..
February ..	0·09	0·53	— 0·44	1
March ..	0·30	0·83	— 0·53	1
Total for the year	19·28	25·27	— 5·99	46

April to May ..	.. 7·66 inches.	Mean based on previous 25 years	25·27 inches.
June to September	.. 4·71 inches.		
October to December	.. 6·52 inches.	Departure from normal	— 5·99 inches.
January to March	.. 0·39 inches.		
Total ..	.. 19·28 inches.		

Rainfall was again below normal for the whole year. The rainfall during the summer months of April and May was in large excess owing to thunderstorm activity, but was in large defect for the remainder of the year, the defect being most marked during the North-east monsoon period. Mean temperature was below normal during the summer months and above the average during winter. Other climatic elements were normal.

5. *Analytical and advisory.*—Table II gives details of samples received and analysed during the year. It does not include samples analysed in connexion with original investigations, and 396 samples of soils collected during the progress of the Gundlakamma Soil Survey.

Table II.

Particulars.	Research.	Agricultural department.	Other Government departments.	Ryots and other private parties.	United Planters' Association of Southern India.	Total.
1 Soils	78	138	11	7	1	235
2 Manures	13	40	..	11	7	71
3 Waters	11	23	6	4	..	44
4 Foods and Fodder ..	95	61	196	2	1	355
5 Cane juices ..	..	1,291	5	..	..	1,296
6 Field experiments ..	292	..	..	..	..	292
7 Miscellaneous ..	71	169	7	4	..	251
Total for 1937–38 ..	560	1,722	225	28	9	2544
Total for 1936–37 ..	177	1,509	134	34	10	1,864
Total for 1935–36 ..	258	853	140	12	26	1,289

All the samples of manures received from the United Planters' Association of Southern India, were accompanied by guarantees of analysis, and on analysis found to differ from the guaranteed analysis. There was not much deviation in the nitrogen content, but in phosphoric acid and potash contents there were large differences, but mostly on the favourable side.

A total of Rs. 370–8–0 was collected as analytical fees, made up of a sum of Rs. 121–8–0, from the United Planters' Association of Southern India, and Rs. 249 from private parties and remitted into the treasury. The corresponding amounts for 1936–37 being Rs. 579 and for 1935–36, Rs. 619.

As was usual in previous years, the section, in addition to analysis and reports of a routine nature, had to deal with numerous enquiries and for advice on matters connected with the chemistry of soils, manures, cattlefeeds, and human foods from officers of the department in connexion with their work, and from officers of other Government departments, i.e., Industries, Jail, Public Health and Medical. Work on soil surveys of irrigation projects on behalf of the Irrigation department was continued and the Gundlakamma project command in the Ongole taluk of the Guntur district was surveyed and work completed during the year. Arrangements were made, during the year, by which analytical work was undertaken for the Coorg administration the samples

sent being paid for at the usual scheduled rates. One sample of soil was analysed and reported on during the year under this arrangement.

Out of the samples analysed, the following is a summary of samples of interest :—

(i) The Superintendent, Agricultural Research Station, Tindivanam, sent a sample of silage, prepared from groundnut haulms for examination. The material analysed as follows :—

Heads of analysis.	Laboratory number 316/1937-38.
	PER CENT.
Moisture	15·23
Ash	17·64
Crude proteins	9·56
Ether extractives	0·54
Crude fibre	29·86
Carbohydrates (by difference)	27 17
Total ..	100·00
Insoluble mineral matter	7·98
Albuminoid and true proteins	8·83
Acid value (in terms of Mg of KoH per gm. of fat)	97·83
Lime (CaO)	2·77
Phosphoric acid. (P_2O_5)	0·46

The sample of silage was a good sample, and fairly rich in its mineral contents, especially lime, and of good nutritive value.

(ii) A sample of the refuse from the cashew nut factory—the spoiled portion of the kernel—was analysed, at the instance of the Deputy Director of Agriculture, VII circle, Tellicherry, to find out its usefulness as a poultry and cattle-feed. This had the following composition :—

Heads of analysis.	Laboratory number 549/1937-38.
	PER CENT.
Moisture	7·07
Ash	2·88
Crude proteins	22·00
Ether extractives	41·92
Crude fibre	3 37
Carbohydrates (by difference)	15·69
Total ..	100 00
Insoluble mineral matter	0·03
True proteins	19·68
Acid value	101·10
Lime CaO	0·34
Phosphoric acid (P_2O_5)	1·30

The sample was a fairly good one and might be useful as a poultry feed. The high acid value indicating spoilage and rancidity would detract from its value as a cattle-food.

(iii) Messrs. A. S. T. F. Rodriguez & Co., are the Managing Proprietors of the Katpadi Manure Works, and dealers in organic manures. Samples of steamed bone-meal, steamed horn-meal and steamed hoof-meal were received from them for analysis and report. On analysis, it was found that the sample of steamed hoof-meal was a good sample while the other two were only average samples, as would be seen from the following data :—

Heads of analysis.	Laboratory number. 634/1937-38. Bone-meal steamed. PER CENT.	Laboratory number. 635/1937-38. Horn-meal steamed. PER CENT.	Laboratory number. 636/1937-38. Hoof meal steamed. PER CENT.
Moisture	6·13	9·27	8·79
Loss on ignition	28·37	84·29	76·78
Insoluble mineral matter ..	6·75	2·59	6·20
Nitrogen (N)	3·84	12·96	12·46
Phosphoric acid (P_2O_5) ..	2·26	1·21	2·45

(iv) The Agricultural Demonstrator, Kadiri, successfully prepared " Poudrette " from the nightsoil available in the taluk, following the instructions given in leaflet No. 67. The sample was received almost in a dry condition and had the following composition :—

Heads of analysis.	Laboratory number 497/1937-38
	PER CENT.
Moisture	3·35
Loss on ignition	11·06
Insoluble mineral matter	56·91
Nitrogen (N)	0·51
Potash (K_2O)	0·54
Phosphoric acid (P_2O_5)	0·72

(v) At the request of the Superintendent of the Central Farm, Coimbatore, a sample of Soya bean plant was analysed for its feeding value with the following results :—

Heads of analysis.	Laboratory number 502/1937-38. On original moisture basis.	Laboratory number 502/1937-38. On dry basis.
	PER CENT.	PER CENT.
Moisture	72·25	..
Ash	2·52	9·04
Crude proteins	6·26	22·45
Ether extractives ..	0·40	1·42
Crude fibre	6·63	23·76
Carbohydrates (by difference)	11·94	43·33
	100·00	100·00

The ash contained fair amounts of minerals—2·3 per cent of lime as CaO and 0·73 per cent of phosphoric acid as P_2O_5 on the dry basis. This plant would form a good cattle-food. Proteins are present in good amounts.

(vi) On a reference from the Superintendent, Agricultural Research Station, Aduturai, enquiring whether Kapok seeds could be utilized as a stock feed, the same was analysed and found to contain the following composition :—

Heads of analysis.	Laboratory number 495/1937-38.
	PER CENT.
Moisture	9·23
Ash	5·09
Crude proteins	24·25
Ether extractives	22·38
Crude fibre	14·13
Carbohydrates (by difference)	24·92
Albuminoids, or true protein	25·82
Acid value	67·03
Lime (CaO)	0·33
Phosphoric acid. (P_2O_5)	1·80

The seeds had a good feeding value and can be useful as a stock feed, provided there is a sufficiency of this material available. The oil content is fairly high, being about 22·4 per cent. Watt mentions in his book " The Commercial Products of India ", that the cake is found to be a highly beneficial cattle food and that the oil is used in Holland as food and also in the manufacture of soap.

(vii) A sample of goats' manure was analysed for the Superintendent, Agricultural Research Station, Nanjanad. This was a good sample as seen from the following data :—

Heads of analysis.	Laboratory number 181/1937-38. On original moisture basis.	Laboratory number 181/1937-38. On dry basis.
	PER CENT.	PER CENT.
Moisture	16·36	..
Loss on ignition ..	60·94	72·86
Insoluble mineral matter.	9·36	11·19
Nitrogen (N)	2·40	2·87
Potash (K_2O)	5·01	5.99
Phosphoric acid. P_2O_5 ..	1·01	1·21

(viii) Samples of farm-yard manure and Indore composts prepared at the Agricultural Research Stations, Nanjanad, Samalkot and Guntur, were analysed for their manurial

values and the results are given in the tabular statement below :—

On moisture free or dry basis.

Heads of analysis	Nanjanad.		Samalkot.		Guntur.	
	Farm yard manure.	Indore compost.	Farm yard manure.	Indore compost.	Farm yard manure.	Indore compost.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Loss on ignition ..	67·26	61·12	20·76	19·66	40·0	22·0
Insoluble mineral matter	15·31	20·04	67·04	57·34	50·0	55·0
Nitrogen (N)	2·06	1·38	0·65	0·73	0·78	0·53
Potash (K_2O)	5·12	4·31	1·63	1·32	1·43	1·71
Phosphoric acid (P_2O_5)-	0·52	0·44	0·50	0·61	0·65	0·17
Humus	23·43	16·43	5·85	5·29	7·21	3·23

It will be observed that the samples vary with the locality and the best product is from the Agricultural Research Station, Nanjanad, where all the organic matter has been conserved in the final product, either the farm yard manure or the Indore compost.

(ix) Connected with the experiments, conducted by the Research Engineer, Agricultural Research Institute, Coimbatore, with the " Cecoco " sheller and polishing machine, obtained by him, the Paddy Specialist, sent two varieties of rices, CO-3 and Pb-10 which were shelled and polished at varying time limits—from one minute up to 10 minutes. Although the results were limited by a single analysis they were rather interesting and would fairly indicate that polishing up to five minutes did not appreciably affect the chemical composition of the rice samples. Seven minutes polishing and beyond lowered the ash values with a corresponding decrease in the lime, magnesia and phosphoric acid contents.

Results of analysis of the different rice samples.

Food values.

Laboratory No. 1937–38. Heads of analysis.	Variety—Co. 5—White—Raw rice. 517 Shelled.	518 Polished for 1 minute.	519 Polished for 2 minutes.	520 Polished for 3 minutes.	521 Polished for 4 minutes.	522 Polished for 5 minutes.	523 Polished for 7 minutes.	524 Polished for 10 minutes.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Moisture	11·09	11·17	11·24	11·34	8·99	11·43	7·28	11·25
Ash	1·469	1·511	1·614	1·485	1·381	1·406	1·198	1·079
Crude Protein	8·527	9·078	8·700	9·003	7·881	8·256	7·745	8.790
Ether Extracts	2·760	2·777	2·419	2·412	2·603	2·538	2·176	1.908
Crude Fibre	0·130	0·217	0·630	0·393	0·253	0·291	0·168	0·378
Carbohydrates	87·114	87·583	86·637	86·707	87·882	87.509	88·713	87·845
Total ..	100·00	100·000	100.000	100·000	100·000	100·000	100·000	100·000
Albuminoids	8·004	8·026	8·392	8·806	7·721	8·196	7·660	8·692

Ash analysis.

Insolubles	0·124	0·071	0·088	0·090	0·084	0·603	0·086	0·093
Iron and Alumina	0·050	0·094	0·093	0·056	0·070	0·040	0·068	0·094
Lime	0·027	0·028	0·024	0·022	0·024	0·027	0·011	0·006
Magnesia	0·123	0·118	0·119	0·107	0·172	0·125	0·060	0·045
Potash	0·245	0·227	0·203	0·284	0·279	0·260	0·300	0·251
Phosphoric acid	0·869	0·814	0·723	0·779	0·803	0·536	0·697	0·742

Results of analysis of the different rice samples—*cont.*

Food values.

Laboratory No. 1937–38 / Heads of analysis.	620 Shelled.	621 Polished for 1 minute.	622 Polished for 2 minutes.	623 Polished for 3 minutes.	624 Polished for 4 minutes.	625 Polished for 5 minutes.	626 Polished for 7 minutes.	627 Polished for 10 minutes.
	Variety—Ptb. 10—Red—Raw rice.							
	PERCENT.	PERCENT.	PERCENT.	PERCENT.	PERCENT.	PERCENT.	PERCENT.	PERCENT.
Moisture	10·46	11·45	11·07	11·08	8·24	9·84	6·90	9·74
Ash	1·769	2·016	1·579	1·597	1·418	1·581	1·325	1·400
Crude Protein	7·280	7·305	7·805	7·321	7·836	7·772	7·747	7·875
Ether Extracts	2·760	2·305	2·203	2·464	1·913	1·959	1·978	2·223
Crude fibre	0·361	0·484	0·642	0·523	0·369	0·287	0·300	0·298
Carbohydrates	87·830	87·890	87·771	87·095	88·464	88·451	88·650	88·204
Total	100·000	100·000	100·000	100·000	100·000	100·000	100·000	100·000
Albuminoids	6·945	6·976	6·276	6·409	6·978	7·008	6·986	6·846

Ash analysis.

Insolubles	0·052	0·123	0·031	0·050	0·040	0·074	0·040	0·036
Iron and Alumina	0·506	0·430	0·395	0·423	0·420	0·434	0·420	0·356
Lime	0·040	0·050	0·023	0·033	0·031	0·024	Trace.	Trace.
Magnesia	0·090	0·090	0·085	0·070	0·081	0·094	0·025	Trace.
Potash	0·304	0·321	0·208	0·256	0·251	0·284	0·238	0·235
Phosphoric acid	0·980	0·909	0·836	0·900	0·698	0·802	0·689	0·488

In another set, shelled, hand-pounded and mill polished rice samples were examined and compared. The shelled samples gave the best results. The hand-pounded one was the next in order, while mill polishing had definitely removed a good deal of the nutrients. It was also observed that ten minutes polishing with the "Cecoco," polisher gave a better product than even hand-pounding. Figures are given below :—

VARIETY Co. 5—RAW RICE.

Head of analysis.	Cecoco machine.		Hand pounding.	Mill polishing.
	Sheller sample.	10 minutes polishing.		
	PER-CENT.	PER-CENT.	PER-CENT.	PER-CENT.
Moisture	11·09	11·25	9·71	10·18
Ash	1·47	1·08	1·12	0·64
Crude proteins	8·53	8·79	7·76	6·78
Ether extractives	2·76	1·91	1·22	0·73
Crude fibre	0·13	0·38	0·03	0·04
Carbohydrates (by difference) ..	87.11	87.85	89·87	91·88
Lime (CaO)	0·027	0·006	0·02	Traces.
Magnesia (MgO)	0·123	0·045	0·067	0·04
Potash (K_2O)	0·245	0·251	0·209	0·076
Phosphoric acid (P_2O_5)	0·869	0·742	0·574	0 368
Iron and Alumina (Fe_2O_3) and Al_2O_3).	0·05	0·094	0·084	0·062

Incidentally it was noticed that the variety Pb-10, a red rice contained very high amounts of iron and alumina, as compared with the other variety CO.5, which is a white rice. Possibly the red colour of the rice sample is associated with the amounts of iron present in the sample. It is intended to pursue this as an investigation in detail this year.

II. RESEARCH.

6. *Soil Surveys of Irrigation Projects—Gundlakamma Project Soil Survey.*—A detailed survey of the project area was completed during the year.

The Gudlakamma rises in the Kurnool district and it finds its way into the sea a short distance from Ongole town. The proposal is to build a dam after the river has entered the Guntur district as a storage reservoir, and to bring the water down the river for distribution, below Addanki. The command will lie to the right bank of the river down to the sea coast.

The soil survey was conducted at the instance of the Irrigation department, to get authentic information on the soils of the command and to determine their suitability for wet crops.

The main findings of the soil survey may be stated as follows :—

(i) The country slopes towards the sea from the head of the command. The slope is however very gentle, the highest contour being 95 feet near Dhenuvukonda and about ten feet above mean sea level near the Buckingham canal.

(ii) The soil is generally a black soil over the greater part of the command with small areas of red soils and mixed soils, and a strip of very sandy soil along the seashore.

(iii) The soils are generally of alluvial origin without any marked profile features and are deep. There is no definite zone of salt concentration, but gypsum crystals occur scattered through the profile.

(iv) The red soils are light, and loamy, and in the south-east contains pebbles and stones near the quartzite rock formation.

(v) The salt content is generally low, being below 0·1 per cent, but near the coast and along the courses of small drainage water courses, has a high salt content of 0·5 and above. This area is comparatively small, and chiefly along the littoral to the south-east of Ongole town.

(vi) In general the soils of the upper half of the command are fertile soils with a salt content within safe limits, and may be considered suitable for irrigation of wet crops.

(vii) Though local opinion is against the use of the water of the Gundlakamma for irrigation purposes, there is no reason to suppose that any harmful effect will be felt as a result of its use, as a periodic analysis of the water from the Gundlakamma river showed a low salt content though the pH of the water was high.

(viii) The water table was generally below 8 feet, except near the littoral and in the small area near water courses where it was less than 8 feet.

(ix) The upper reaches of the command, down to a few miles north and north-west of Ongole may be stated to be suitable for irrigation for growing wet crops.

7. *Reclamation of saline lands in the Kattalai High Level channel area.*—In the report for last year it was pointed out that certain lands in the command of the Kulitalai High Level channel were highly alkaline, not due to the supply of water, which was from the Cauvery river, but owing to rise of water table caused by impeded drainage. The land affected had a pH of above 10·0 and would support no crop growth. The soils on analysis were seen to have a high pH. due to presence of carbonates and bicarbonates of sodium in excessive amounts though the total soluble salt content was not high. This was the case with the top as well as the lower layers of soil, and pointed clearly to the need for keeping the drainage clear and functioning properly

Work was started during the year on a plot of land very badly affected, at Mettumarudur village in the Kulitalai taluk. The treatment consisted of sulphur and gypsum applied at varying doses, with a plot as control in which mere washing out with channel water was resorted to. The sulphur plots were treated

in October 1937 and the gypsum plots in January 1938 and samples of soil were taken in March 1938. Table below gives details of analysis before and after treatment :—

Table.

Before Application.

Plot number and Treatment.	Total solids.	CO3.	HCO3.	SO3.	PH.
1 Sulphur 1 ton	·345	·078	·069	·021	10·08
2 ,, 2 tons	·312	·071	·078	·018	10·17
3 Gypsum 10 tons	·333	.083	·064	·014	10·16
4 Do.	·283	.062	·082	·017	10·14
5 Sulphur 2 tons	·325	·083	·055	·022	10·31
6 ,, 1 ton	·379	.069	·046	·044	10·21

After Application.

1 Sulphur 1 ton	·369	·024	·0458	·123	9·69
2 ,, 2 tons	·647	·0135	·0397	·272	9·61
3 Gypsum 10 tons	·472	·0165	·0366	·213	9·48
4 Do.	·556	·0030	·0198	·290	8·61
5 Sulphur 2 tons	·914	·0105	·0458	·402	9·46
6 ,, 1 ton	·839	.0195	·0488	·259	9·68

The results of the treatment are striking. The treatment with gypsum resulted in the almost total absence of alkali carbonate, and a pH. which was considerably lower than before treatment. Sulphur had not completely been oxidised, but had also been fairly effective at the end of six months. The plots will now be flooded, washed out at the time of the receipt of water in the High Level channel and subject to further treatment by growing and ploughing in of green manure crops before the next paddy season.

The same soil was treated in a similar manner in pot culture experiments at Coimbatore. The results were erratic,, but showed a similar result. The treatments given were with sulphur and molasses. Sulphur gave a better lowering of pH. at 1 ton per acre than molasses at 10 tons per acre. Paddy seedlings were raised successfully in the treated pots.

8. *Investigation on the black soils of Madras Deccan.*—The work reported on last year on the black soils of Madras Deccan was followed up during the year. During the course of work on the soil survey of the Tungabhadra Project command (vide report on the Soil Survey of the Tungabhadra Project, 1938, pages 14–16) a hypothesis was advanced that the black soils of the Madras Deccan were a distinct type by themselves, and were found mostly *in situ*, their specific chemical and physical characters being due to the nature of the parent rock from which they were formed. Their genesis according to the hypothesis is correlated to the minerological composition of the parent rock. The differences in the composition of the parent rock are reasons for soil diversity in a tract with a uniform climatological history. Preliminary work done last year, showed that the black soils and red soils could be thoroughly differentiated by the silica sesquioxide ratio

in their clay complex, the former with the ratio of 3 and above and the latter of 2 and below, ending with low values for laterite soils and intermediate values for red and mixed soils.

During the year work was carried out on the soils from all horizons of a number of profiles excavated and samples collected during the soil survey field season in 1935–36 of the Project area in the Deccan districts of the presidency. The clay fraction was isolated and subject to detailed analysis and table below gives some of the results of the study of the silica-sesquioxide-molar ratio.

Table.

Profile pit number.	Description.	Depth of horizon.	SiO_2/R_2O_3 molar ratio.
1	Dry	12″—24″	3·7
1	,, ...	36″—48″	3·7
1	,, ...	56″—72″	3·91
41	,, ...	0″—12″	4·55
41	,, ...	24″—36″	3·99
41	,, ...	52″—64″	4·13
98	,, ...	0″—12″	3·04
98	,, ...	24 —36″	3·19
98	,, ...	48″—60″	3·49
98	,, ...	72″—84″	3·39
100 A	Irrigated	0″—12″	3·17
100 A	,, ...	24″—36″	3·18
100 A	,, ...	48″—60″	3·30
100 A	,, ...	72″—84″	3·24
188 A	,, ...	0″—12″	2·83
188 A	,, ...	24″—36″	3·00
188 A	,, ...	48″—60″	4·22
51 B	Dry	0″—12″	2·98
51 B	,, ...	24″—36″	2·86
51 B	,, ...	48″—60″	3·01
51 B	,, ...	72″—90″	3·10
41 A	,, ...	0″—12″	3·71
188 A	Irrigated	0″—12″	3·41

The results are definite in pointing to the fact that the black soils whether from dry or irrigated soils have a uniform high SiO_2/R_2O_3 molar ratio of the clay complex. It is noteworthy to record here that the soils under irrigation which have been studied, have been under irrigation for centuries, under canals taking off from small barrages built during the time of the principality of Vijianagar which had its capital at Hampi which now lies in ruins and the length of time of a continuous regime of irrigation may be estimated at 300–400 years at the least.

The clay fraction of any soil is its active constituent and when it has been shown that this constituent has got a uniform composition, at all horizons of the profile and even after a long continued period of irrigation, the conclusions are that—

(i) the soil is an extraordinarily stable system capable of withstanding external influences to alter its composition; and

(ii) the theory that the black soils form an entity by themselves, which cannot have been derived from other types of soils, would appear to be entirely justified, and supports

the hypothesis advanced about their origin being distinct from that of other soils.

(iii) The black soils, including those near the river Tungabhadra, are homogeneous soils without any sign of unconformity at the different depths as seen by the uniform chemical composition. The theory that they are transported soils is therefore negatived. Further work is in progress and will be reported on as it progresses.

9. *Effect of irrigation on black soils.*—Work on this problem was started at the new Agricultural Research Station at Siruguppa, Bellary district. Assistant Agricultural Chemist, M.R.Ry. C. V. Ramaswami Ayyar Avargal, was posted for work there and is in charge of the station.

An area of 90 acres selected last year was acquired and buildings were under construction. The lay out of a part of the area was undertaken and work is in progress.

The work at that station is divided under two branches—

(i) *Fundamental*—being physico-chemical studies on the soils, to study changes in the salt profile in the soils and studies on the structure and composition of the soil as affected by irrigation, and

(ii) *Agronomic*—studies on the water requirement of crops, and different depth of irrigation, and a study of new varieties of crops and new crops to be introduced in the Ceded districts after the advent of the Tungabhadra Project.

No chemical work could be started as the laboratory building was not completed. Work on Agronomic problems is described in detail in the Annual report of the station, submitted separately.

10. *Field experiments*—(i) *Green manure experiments.*—The experiment was continued this year to show the residual effect. The table below gives yield obtained in the experiment for the two years—1936–37 and 1937–38.

Residual effect.—Second year—Yield in pounds per acre.

Serial number and Treatment.	1937–38.		1936–37.	
	Grain.	Straw.	Grain.	Straw.
	LB.	LB.	LB.	LB.
1 Control (No manure).	2,739	2,782	2,955	3,294
2 Green manure—2,000 lb. ..	3,003	3,117	2,987	3,747
3 Do. 4,000 ,, ..	2,835	3,354	2,790	3,214
4 Do. 6,000 ,, ..	2,877	2,925	3,095	3,495
5 Do. 8,000 ,, ..	2,893	2,968	3,123	3,486
6 Do. 10,000 ,, ..	2,484	2,736	3,155	3,345
7 Do. 12,000 ,, ..	2,891	2,998	3,098	3,482

It is again observed that as in previous years that plots which received 6,000—8,000 lb. of green manure, have given the best

results. The yields were in general lower this year owing to an unfavourable season, and also to the year being the second year of residual effect. The yield data when examined statistically was not significant this year.

(ii) *Molasses experiment.*—In the wet lands a second year residual effect experiment was conducted with paddy. The results are given below for the two years 1936–37 and 1937–38 and that for 1935–36, the year of application of molasses.

Table.

Yield in pounds per acre. Paddy Co. 1.

Treatment.	1935–36.		1936–37. Residual 1st year.		1937–38. Residual 2nd year.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	LB.	LB.	LB.	LB.	LB.	LB.
1 Control	1,990	3,455	2,503	3,910	2,896	2,869
2 Five tons Molasses ..	2,770	3,300	2,634	3,586	2,807	2,926
3 Seven and half tons Molasses.	2,829	3,149	2,475	3,437	2,872	2,778
4 Four tons molasses plus Ammonium sulphate.	3,085	3,487	2,468	3,738	2,646	2,632

The control plot gave increased yields in the two years of residual effect, while no residual effect was to be seen in the plots treated with molasses. The yields were all statistically significant. The experiment will be discontinued from now, as it has been shown that molasses has no residual manurial value.

(iii) *Activated sludge plant effluent for paddy.*—This experiment was continued this year, taking care that the irrigation with the effluent was started after the paddy seedlings had established themselves with irrigation with channel water till they established themselves. Table below shows yields of grain and straw averaged over the eight plots :—

	Grain.	Straw.
	LB.	LB.
Effluent water	3,229	4,465
Channel water	3,135	3,146

The increase in grain in favour of effluent water is 3·0 per cent while it is 42·0 per cent in straw, over the channel water plots. The results are statistically significant. The response was better in vegetative growth when effluent water was used.

(iv) *Sullage water for paddy.*—This experiment was also a continuation of experiments conducted last year on the use of large volume of sullage water from the College Estate, which was not treated by the Activated Sludge Plant, but passed on direct to the wet land fields.

The sullage water was applied after dilution in the ratio of 1 :3 with channel water. Results of harvest were as follows :—

	Grain.	Straw.
	LB.	LB.
Channel water	2,121	2,273
Sullage water	3,252	4,471

The increase in yield of grain was 21 per cent and 64·8 per cent in straw, in favour of the sullage water plots. The results were statistically significant.

11. *Plant nutrition*—(i) *Plantain analysis.*—Forty-two different varieties of plantains grown in the Central Farm, Coimbatore, by the Herbareum section of the Principal, Agricultural College, Coimbatore, were analysed in the year under review, for their sugars (both reducing and non-reducing), ash, nitrogen and minerals. The total sugars content varied from 15 per cent to 28 per cent. No large variation was observed in the ash and protein contents. The undetermined, composed of fat, fibre, etc., also varied from almost nil to nearly 15 per cent.

On an average, the pulp of the fruit contained 0·4 to 0·7 per-cent of potash as K O, Lime and Phosphoric acid were present in small amounts. The value of the plantain is not in its mineral content, but in the starch and sugars. Some of the varieties, like the Red Banana and Manoranjitam contained high amounts of non-reducing sugars, about 60 per cent of the total sugars in the Red Banana and 45 per cent in the Manoranjit were present as non-reducing sugars. Neypoovan, another variety, contained the maximum amount of pulp in the fruit, about 92 per cent. The total sugars were 28 per cent, but the non-reducing sugars were present only 4 per cent (i.e.), about 14 per cent of the total. In some other varieties, like Pey-Ladan, Cheru-Vannan, all the sugars were present only as reducing sugars.

Below are given the analytical data of a few varieties selected to demonstrate the above observations.

Results of analysis of the edible portion (pulp) of a few plantain varieties grown at the Central Farm, Coimbatore.

Name of variety.	Chakkarakeli laboratory number 719/36–37.	Cheruvannan laboratory number 711/36–37.	Anaikomban laboratory number 141/37–38.	Vamanakeli laboratory number 152/37–38.	Neypoovan laboratory number 291/37–38.	Sirumalai laboratory number 337/37–38.	Manoranjit laboratory number 343/37–38.	Red Banana laboratory number 576/37–38.	Pey Ladan laboratory number 685/37–38.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Average weight of a single fruit in grams.	58·7	71·7	126·3	180·3	97·1	126·8	96·5	89·9	74·2
Pulp to whole fruit ..	69·0	73·5	69·4	71·7	91·8	77·1	80·7	79·3	66·73
Moisture	71·80	65·15	73·53	78·48	65·94	69·93	75·02	75·02	66·28
Ash	1·10	0·99	1·63	0·88	1·00	0·97	0·91	0·91	0·84
Proteins	1·73	1 54	1 30	1·00	1·00	1·03	1·28	1·49	1·10
Reducing	13·70	17·99	11·00	10·02	23·60	22·14	12·18	7.05	22·95
Non-reducing	3 37	0·18	7·83	5·02	4·12	1·48	9·72	1·80	
Fat, Fibre, etc., (by difference).	8·30	14·15	4·71	4·60	4·34	4·45	0·89	1·73	8·83
Pime (CaO)	0·037	0·042	0·085	0·12	0·071	0·073	0.070	0·099	0·05
Phosphoric acid (P_2O_5) ..	0·097	0·069	0·058	0·055	0·068	0·072	0·083	0·062	0·06
Potash (K 20)	0·62	0·57	0·52	0·53	0·53	0·50	0·47	0·51	0·46
Nitrogen (N_2)	0·26	0·23	0·21	0·16	0·16	0·17	0·20	0·24	0·18

(ii) *Citrus disease.*—An investigation was started in collaboration with the Government Mycologist, and the Deputy Director of Agriculture, II Circle, Guntur, on the causes of the disease of the citrus in gardens in Patamata and Patamata lanka near Bezwada. It was first supposed that the disease was primarily due to the contamination of the soil and water by the waste water from tanneries, in the vicinity of the gardens. The soil and water of the area were examined and the disease found to be a fungus disease which was present even in gardens far away from the tanneries. It was seen that the disease was associated with a pH. of 8·5. Remedial measures were suggested for soil disinfection and lowering of the alkaline reaction by application of sulphur. The work is in progress.

12. *Animal nutrition*—(i) *Maintenance requirement of bullocks.*—The concluding series of experiment was conducted during the year with Kangayam bullocks on the minimum protein requirement for maintenance at rest. This work has been in progress for a number of years and has been conducted on Ongole bullocks and on three batches of Kangayam bullocks. The method of experimentation has been uniform in the whole series, consisting in the determination of the nitrogen balance, when the animal is standing in a stall, a condition representing the needs of bullock for protein during periods of rest or of no work. The protein content of the ration was adjusted to equate it with the nitrogen output, which means that the food supplied just enough nitrogen to meet requirement.

The large amount of data accumulated will now be subject to statistical analysis before publication.

The results of this long series of experiment may be stated now with confidence, that for a mature bullock of the Madras breeds of animal, the requirement for protein is in the neighbourhood of 100 grams digestible protein per 1,000 lb. live weight.

It is interesting to state that the value is considerably lower than the standard in common use in Europe and America, and set up by the work of Armsby, of 300 grams digestible protein per 1,000 lb. live-weight for maintenance.

(ii) *Protein metabolism and muscular work.*—During the course of the work on the determination of the protein requirement of bullocks for maintenance and work of varying intensity it was found that the nitrogen output of animal increased when light medium or heavy work was given. A long series of experiment was therefore carried out to assess the nitrogen requirement for work. The results of such experiment have been reported from time to time in the annual reports. It has been held till now that muscular work on the part of a mammalian organism calls only for an additional supply of calorigenic material in the shape of carbohydrates, as work calls for additional heat energy. The needs of an animal organism for nitrogen has been considered to be negligible or non-existent. The school of Physiologist in Glasgow

lead by Cathcart, however, held that nitrogen is necessary in addition to calorigenic material for an animal organism to meet its need for repair of tissue in the course of the performance of muscular work. The work of that eminent physiologist on human subjects, failed to provide definite evidence on the heightened protein metabolism. The work done by this section during the past few years with bullocks as subjects, on the protein metabolism of muscular work has been definite in establishing the fact that during muscular work of a measurable and regular type, the bullock showed a heightened metabolism of protein, correlated with their energy expenditure. Further it has been shown that the quantum of protein required is correlated with the quantum of work performed.

Detailed studies were carried on during the year under report to measure the quanta of work and quanta of protein. Work was given to the experimental animals at the mhote, where work was regulated by the number of buckets of water raised a given height.

The results obtained this year were confirmatory of results recorded previously and may be summarized as below :—

(i) The quantum of protein required is a linear function of the quantum of work, performed, in the limits of 4, 6 and 8 hours work, the exact proportion being 26 : 32 : 38 : : 4 : 6 : 8 for the present set of experimental animals which are of the Kangayam breed of approximately 900 lb. weight.

(ii) The product of tissue breakdown appears in the urine wholly as urea and ammonia, the quantities of creatinine being practically constant at all planes of work. The appearance of creatine being occasional and sporadic.

As a piece of research this work has established a fundamental fact, that in the bovine mammalian organism, protein is required for work though it has not been seen to be so in the human organism.

The practical significance is that the bullock requires additional protein and not only carbohydrate material for calorigenic purposes.

It will now be possible to make definite recommendations on the rations for a working bullock, and this will be done during the coming year in the Government farms.

With these results an average ration for a Kangayam bullock would be—

	Cotton seed.	Cholam straw.
	LB.	LB.
For resting condition	0·6	15—20
Light work	1·0	15—20
Medium work	1·75	15—20
Heavy work	2·2	15—20

(iii) *Biological value of cereal proteins.*—A long series of experiments was conducted with the white rat as subject on the biological value of cereals grown under different manurial treatments. The cereals were grown on the Old and New Permanent Manurial plots at the Central Farm, Coimbatore. The crops experimented on were, ragi and cholam from the Old Permanent Manurials, and ragi and pannivaragu from the New Permanent Manurials.

The results of experiments using the Mitchel technique of nitrogen balance, for the determination of the biological value was variable and showed a difference between the cereals grown on the Old Permanent Manurial and in the New Permanent Manurial plots. The old Permanent Manurial grains showed a superiority of cattle manure grains, in their digestibility, co-efficient and biological value, while in the grains from the New Permanent Manurial plots no such effect was seen and the cattle manure grain showed no superior nitrogen value as may be expected. Work is in progress on this problem which has far-reaching influence on problems of nutrition, which would appear to depend on the conditions under which grain is grown.

(iv) *Biological value of rice from effluent water and channel water plots*—[*Cf. paragraph* (iii) *above*].—The paddy produced by the plots in the Central Farm, Coimbatore, wet lands, under irrigation by effluent water and ordinary channel water was subjected to biological assay for the biological value of the rice. Table below gives results of the experiment :—

	Protein.	Protein content of diet.	Digestibility coefficient.	Biological value.	Net protein value.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Channel water rice ..	7·63	5·67	93·30	89.75	6.39
Effluent water rice ..	10.40	5.65	89.98	88·58	8·29

The rice grown with effluent water had a protein content of 10·40 per cent against 7·65 per cent of channel water rice. The digestibility co-efficient and biological value was about equal while the net protein value of the effluent water rice was appreciably higher.

Effluent water from the activated sludge plant, with its high nitrogen content was responsible for the higher nitrogen content of the grain and its higher net protein value.

(v) *Sulphur metabolism of sheep.*—Following up on the work on the sulphur metabolism of sheep as reported on last year, a preliminary study was carried out on the biological oxidation and transformations concerned in the metabolism of sulphur in the sheep.

It was established in work reported on during last year that the sheep when fed with elemental sulphur retained some of it and the remainder was excreted as sulphate sulphur in the urine. The site of the metabolism was suspected to be in the sheep's rumen with its wealth of microbiological fauna and flora. Preliminary work during the year was carried out on the mixed flora and fauna of the gastro-intestinal tract of the sheep, taken fresh after slaughter, and the culture inoculated in flask containing culture media with elemental sulphur. Results indicated that elemental sulphur was converted into sulphate sulphur, while no distinct conversion was noted with sulphate sulphur. Cystine sulphur underwent a rapid change also into sulphate sulphur. It would seem that as expected the rumen is the seat of activity when the metabolism of sulphur is concerned. Further work is in progress.

N.B.—(vi) Mineral metabolism of calves and cows.
(vii) Blood tests for mineral defficiency.
(viii) Poultry Nutrition.
(ix) Mineral contents of pastures.
(x) Manurial experiments on pastures.

These items of work were carried out under a grant from the Imperial Council of Agricultural Research and have been reported on in detail in a separate report.

13. *Microbiology*—(i) *Azotobactor studies.*—The method of inoculating cereals before sowing by steeping in a culture of Azotobactor was studied on a field scale with ragi, cholam and wheat. Ragi gave positive results, the increase in grains and straw over the control plot yield and the results were statistically significant. The experiment with wheat gave no increase and yield data were not statistically significant. The experiment with cholam failed owing to some disease in the seedlings, and was abandoned.

(ii) *Legume nodule work.*—The investigation on the nodule bacteria of Indian legume was continued. The work consisted of three parts—

(*a*) Cross-inoculation studies on Agathi and *Sesbanea speciosa.*

(*b*) Strain variations in nitrogen fixation.

(*c*) Influence of different levels of moisture on the symbiotic fixation of nitrogen.

(*a*) *Cross-inoculation studies.*—Four new strains of nodule bacteria from Agathi, *Sesbanea grandiflora* and *Sesbanea speciosa* nodules were isolated in pure cultures and tested for their purity on potato slant, litmus milk and marmite mannitol agar slants. They proved to be pure on these media. These cultures along with 25 other representative groups of bacteria were inoculated on Agathi, *Sesbanea speciosa* and redgram plants under controlled condition in the pot culture house. After a month's growth the plants were harvested and the roots were examined for nodule production. It was found that only Dhaincha organisms and the

four new strains of Sesbanea plants could produce nodules, thereby showing that these host plants belong to the Dhaincha bacterial-plant group.

(iii) *Studies on the keeping quality of milk.*—The keeping quality of milk obtained from the College Dairy and from outside sources was studied in a series of 17 experiments using the old domestic practice of boiling before use, as is common in South India.

It was found that boiling milk for 5 minutes results in—

(*a*) the complete destruction of B coli;

(*b*) a reduction in the total bacterial count to an insignificant figure, all types of milk coming to the same level as regards bacterial count, irrespective of initial population;

(*c*) increase in titrable acidity, probably due to either concentration as a result of boiling or a breakdown of the casein, partially into amino acids, or liberation of free fatty acids of the fat;

(*d*) practically no destruction of the thermophylic bacteria; and

(*e*) keeping boiled milk, it was found that the rate of multiplication of bacteria was negligible, while the thermophylic bacteria increased slightly probably owing to lack of competition from mesophilic types.

It was seen that filtering milk removes a good proportion of bacteria present in original milk and improves keeping quality.

The old South India practice of boiling milk is thus shown to be a very safe one in domestic hygiene.

14. *Sugarcane and sugarcane products—Studies on jaggery.*—A study was undertaken on the physico-chemical properties of jaggery in relation to quality and keeping quality. Seventy-two specimens of jaggery were prepared at Anakapalle from canes grown under different treatments and from different varieties of cane, and subjected to a detailed study. Jaggeries are now usually classified under the two heads of " good " and " bad," a classification which is very indefinite and crude. Chemical analysis done does not give any definite ground for classification. There are other factors which take part in determining quality. The chief factors so far seen as a result of these studies are (i) crystal size, (ii) structure of the jaggery, (iii) moisture absorption and (iv) proportion of matrix to the crystal structure. It was also seen that arrowing of the cane and treatment influence these factors which determine quality in jaggery. These studies have shown that jaggeries can be classified as follows based on their internal structure :—

(i) Crystalline and dry,

(ii) crystalline and moist, and

(iii) micro-crystalline and moist.

The first class includes the " good " jaggery, the second and third being " medium " and " bad."

15. *Nitrogen content of cane juices and its effect on colour of jaggery.*—Preliminary work has shown that the development in colour during jaggery-making, even after filtration is correlated with the presence of nitrogenous substances in the cane juice. It would appear that the presence of amino groups in the juice cause the development of colour during the boiling of the decolourized juices. This is in line with work done elsewhere on the production of dark-coloured substances during the hydrolysis of a protein by the interaction of amino groups with the aldehyde groups. A cane juice with a high nitrogen content gives dark-coloured jaggery even after filtration through carbon.

16. *Arrowing of sugarcane.*—The phenomenon of arrowing is common in the seedling varieties of cane and is viewed with apprehension by ryots. This problem was taken up during the year, and it was seen that during arrowing (i) there is a tendency for the cane to produce flowers as the carbon : nitrogen ratio of the top of the cane increases ; (ii) the cane begins to dry progressively from the top downwards ; (iii) the extraction percentage decreases as a result of arrowing while the sucrose content remains constant.

17. *Maturity of cane.*—The usual tests of a top/bottom ratio approaching unity, high purity and high concentration of sugar are not always valid as criteria of ripeness of cane. Studies have shown that a low glucose and low nitrogen content are better criteria.

18. *Active carbon.*—Active carbon from paddy husk was prepared on a bulk scale and 3,000 lb. so produced. The quantity distributed for departmental officers amounted to 1,500 lb. for demonstration of cream jaggery-making.

19. *Jaggery from palm juice.*—A procedure employing the removal of lime from the juice by superphosphate and filtration through active carbon was worked out, which gave a satisfactory product free from the characteristic toddy flavour, from palmyra and coconut juice.

AGRICULTURAL RESEARCH INSTITUTE,
LAWLEY ROAD P.O., COIMBATORE,
15*th May* 1938.

P. VENKATARAMIAH,
Government Agricultural Chemist.

ADMINISTRATION REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR THE YEAR 1937–38.

I

I beg to submit the following report on the activities of the Entomological section for the year ending 31st March 1938. The section completed 25 years of its useful existence on 24th April 1937.

II. Charge.

I continued to be in charge of the section as Government Entomologist throughout the year under report.

III. Enquiries and noteworthy pests of the year.

During the year under review 389 enquiries were received by the section from different parts of the Presidency. These referred chiefly to insect pests of crops and bee-keeping. In addition to those received by the section, the Entomological Assistants posted in the districts under circle officers also dealt with a number of enquiries. The following are some of the noteworthy pests which received attention during the year :—

(1) *Epilachna* beetles on brinjals from South Arcot and parts of Coimbatore.

(2) *Myllocerus* sp. on mango shoots from the Fruit Research Station, Kodur.

(3) The Moringa hairy caterpillar (*Eupterote mollifera*) defoliating Portia trees from Negapatam and Korukkai.

(4) *Cirphis* sp. on grasses from Hosur Cattle Farm.

(5) *Mylabris* sp. on orange flowers from Kodur Fruit Research Station.

(6) *Thrips* on chillies and onions from Coimbatore and Kovvur, on cardamoms from Bodinayakanur and on paddy from Coimbatore.

(7) Mites on sugarcane from Maruteru ; on groundnut from Palur ; on citrus from Kodur ; on curry leaf from Erode , on cholam from Salem ; on arecanuts from Tellicherry ; and on *Barleria cristata* from Madras.

(8) The Pomegranate fruit borer (*Virachola isocrates*) from Coimbatore and Erode.

(9) Aphids on cotton, lablab, citrus, etc., from parts of Coimbatore and on mango seedlings from Rajapalayam.

(10) The Sunnhemp hairy caterpillar (*Utethesia pulchella*) from Samalkot.

(11) Coccids on figs from Hyderabad.

(12) Woolly Aphis (*Eriosoma lanigera*) on apples from the Nilgiris.

(13) The Jasmine bug (*Antestia cruciata*) from Madras.

(14) The coconut caterpillar (*Nephantis*) from West Coast.

(15) *Scotinophora* sp. on paddy from Conjeeveram.

(16) *Orthezia* sp. on lantana from Coorg.

(17) The mango hopper (*Idiocerus* sp.) from Udamalpet, Egmore and Khairpur State.

(18) *Galerucida bicolor* on yams from Koduvayur and on cinnamon leaves from Cannanore.

(19) *Spodoptera* sp. on paddy from Mannargudi and Tiruturaipundi.

(20) Red ants on mango seedlings from Taliparamba.

(21) The paddy mealy bug (*Ripersia oryzæ*) on paddy from Elappulli (Malabar).

(22) *Laphygma* sp. on ragi seedlings from Chingleput.

(23) Cockchafer grubs damaging grass lawns from Ootacamund.

(24) The Prickly-pear Cochineal (*Dactylopius tomentosus*) from Tuticorin and Nagpur.

(25) The coffee shoot borer (*Xyleborus* sp.) from Devarshola (Nilgiris).

(26) The Nettle grub (*Thosea* sp.) from Mundakayam.

(27) The white borer of coffee (*Xylotrechus*) from Yercaud.

(28) The grasshopper (*Hieroglyphus nigro-repletus*) on cumbu from Guntur.

(29) Sugarcane borers (*Diatræa* and *Scirpophaga*) from South Kanara.

(30) The mango stem borer (*Batocera*) from Palladam.

(31) The red hairy caterpillar (*Amsacta*) from Coimbatore, Salem, Tanjore, Poona and Surat.

(32) *Cosmophila* sp. on jute from Coimbatore.

(33) The castor seed borer (*Dichocrocis punctiferalis*) on cardamoms from Puttur and Coorg.

(34) Jassids on ragi seedlings from Kugalur and on brinjals from Tudiyalur.

(35) The castor slug (*Parasa lepida*) on mango from Dharmapuri.

(36) *Prodenia* on cabbage from Valparai.

(37) Fruit sucking moths (*Ophideres*) from Hyderabad.

(38) *Agromyzid* borers in beans from Valparai.

(39) Aleurodids infesting gooseberry leaves from Gingee.

(40) The coconut beetle (*Oryctes rhinoceros*) from Manjeri and Pugalur.

(41) *Lepidosaphes* sp. on betelvine from Perambalur.

(42) *Pulvinaria psidii* on chillies from Salem.

(43) *Pseudococcus* sp. on cotton from Perambalur.

IV. Special Investigations.

A short account of the investigations undertaken during the year is given below. Special attention was paid to the study of control methods for some of the more important crop pests in this Presidency.

1. *Sugarcane pests—Diatræa venosata.*—A good deal of interesting data have been collected regarding this pest of canes. Eggs are laid on the upper surface of cane leaves along the mid rib and the just hatched larvæ enter the central whorl of leaves and scrape the green matter in longitudinal patches. After some days the caterpillars enter the heart of the shoot and feed on the contents. Pupation takes place outside the larval gallery between the stem and the leaf sheath. Extent of damage to canes was worked out in different localities.

Scirpophaga.—Studies on Scirpophaga were continued. The incidence of the pest in certain localities was as high as 28 per cent. Several larval parasites, viz., *Stenobracon nicevillei*, Bingh., *S. deesæ*, Cam., *Rhaconotus scirpophagæ*, Wlk., *Rhaconotus*, n.sp., *Elasmus zehntneri*, Ferr., *Goniozus*, n.sp., and *Shirakia* sp. have been collected of which detailed studies were made of three. Regarding the species of *Scirpophaga* present in South India it was found that both the spotted (*monostigma*) and spotless (*auriflua*) forms were got from the progeny of either. It was observed that there were gradations even in the size of black spots. Some moths had prominent spots with about 100–150 black scales while others had very few scales. The table given below gives the result of four rearings in potted plants inside wire guaze cages :—

Parents.	Number of larvæ liberated.	Number of successful rearings.	Moths with prominent dot.		Moths with less prominent dot.		Moths with 1 or 2 scales on one wing.		Moths with no dot.	
			♂	♀	♂	♀	♂	♀	♂	♀
Moths with prominent dot ..	44	21	9	7	..	..	..	..	5	0
Do. do. ..	13	7	5	1	..	..	..	..	..	1
Do. do. ..	32	20	6	9	1	2	..	1	..	1
Moths with no dot	45	38	..	..	2	..	3	1	16	16

Control experiments for borers.—Experiments were started to see whether the treatment said to be successful in Mysore was effective under Coimbatore conditions. When the plants were

four to five weeks old the following treatments were given :—(1) removal of basal leaf sheath. (2) earthing up of young canes so as to cover the basal leaf sheaths accompanied by a good irrigation, (3) combination of (1) and (2). These treatments together with the control were replicated thrice. The results of the first two counts are given below :—

Treatment.	Percentage of infestation.	
	First count.	Second count.
Basal leaf sheath removal ..	21	47
Basal leaf sheath removal and earthing up.	13	20
Earthing up	9	20
Control	26	42

It will be seen from the table that in the first and second counts, earthing up and basal leaf sheath removal plus earthing up gave least infestation. The final count will be taken at the time of harvesting the canes.

Mealy bugs.—There are two species of mealy bugs attacking the stems of which one is *Ripersia sacchari*. Dipping the cane setts in crude oil emulsion and fish oil rosin soap before planting has been tried on a small scale but the results have not been quite satisfactory. This will be repeated with the addition of a few other treatments. Two species of mealy bugs were noted for the first time on cane roots.

2. *Cotton pests—Cotton bollworms.*—During the year under review detailed studies were made of the alternate host plants of the bollworms. (1) *Abutilon hirtum*, (2) *A. indicum*, (3) *A. crispum*, (4) *Hibiscus panduraiformis*, (5) *H. vitifolius*, (6) *H. esculentus*, (7) *H. rosasinensis*, (8) *Pavonia corea*, (9) *Malvastrum coramandelium*, and (10) *Althea* sp. were examined at various periods. Of these, (1), (2), (5), (7), (9) and (10) carried infestations of both *Earias fabia* and *E. insulana*. *Hibiscus esculentus* and *H. vitifolius* carried a heavy infestation of *Earias fabia*, the incidence being as high as 33 per cent and 15 per cent respectively. *Platyedra gossypiella* caterpillars have been collected for the first time from *Hibiscus esculentus* pods. Incidence studies of bollworms in the shed buds and bolls of Cambodia cotton in a plot of 20 cents showed that infestation by *Earias* ranged from 55 to 48 per cent in the middle of December but dropped to 4 to 7 per cent in the middle of January. *Platyedra* infestation occurred as early as the first week of December but seldom exceeded 1·5 per cent. The following parasites were reared from the bollworm caterpillars :—(1) *Microbracon lefroyi*, (2) *Microbracon* sp. (3) *Bassus* sp., (4) *Melcha nursei*, (5) *Rhogas testaceous*, (6) *Chelonus* sp., (7) *Actia æqyptia*, (8) *Desmemotopa* sp., and (9) *Elasmus johnstonii* from *Earias* and *Goniozus* sp. from *Platyedra*.

The results of the examination of green bolls from Cambodia cotton in the Central Farm and the Anamalais in January–February were as follows :—

Central Farm—Platyedra 17·8 per cent and *Earias* 2·8 per cent.

Anamalais—Platyedra 8·1 per cent and *Earias* 3·6 per cent.

Tarache notabilis.—A severe outbreak of these caterpillars was noticed on cotton seedlings about a month old in the Cotton Breeding Station in October. Prompt handpicking and destruction of caterpillars reduced the severity of attack. The pest would appear to go through long cycle pupal stages immediately.

Observations were also made on the cotton scale (*Saissetia* sp.) and the cotton jassids (*Empoasca devastens* and *E. formosana*).

3. *Paddy pests—The paddy stem borer* (*Schœnobius incertellus*).—Seasonal studies of the fortnightly plantings in the Paddy Breeding Station were concluded. The results of the studies of the 86 strips are being tabulated and the figures analysed with a view to getting the relationship, if any, between the weather factors and infestation at different stages of the crop.

In the Central Farm, light trap trials against the paddy stem borer were continued. Petromax (200-candle power) light was used for two hours from 7 to 9 p.m. for 70 days. The variety of paddy under trial was G.E.B. 24. The figures of infestation at the earhead stage at different distances from the light are given below :—

Near trap 10 yards.	60–70 yards.	120–130 yards.	180–200 yards.	240–250 yards.	300–310 yards.	Beyond 360 yards.
PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.	PER CENT.
0·37	0·20	0·31	0·79	0·49	0·42	1·16

It is seen that the effect of the light trap is felt most at a range between 60 and 130 yards from the light as measured by the percentage of infestation. Some experiments have been started during the year to study the effect of the traps in the earlier stages of the crop also.

The Army worm of paddy (*Spodoptera mauritia*).—Studies on the pest were directed to note the peculiarities, if any, during the larval or pupal period of the insect under natural conditions during the different parts of the year. So far, no sign of æstivation or hibernation was noticed. In this connexion, the allied cutworms—*Cirphis albistigma*—collected on grasses from Hosur were also under special study.

4. *Pests of fruit trees—Fruit flies.*—Two fruit flies—*Carpomyia vesuviana* and *Dacus correctus*—were studied in detail. Both are pests of ber fruits at Panyam and Coimbatore. The results of

the studies during the year have shown that the former is not known to feed on any fruits other than ber and has no attraction to lures. The latter has a range of food plants such as sandal fruits, pumpkin flowers, guavas and oranges and has an attraction for *Clensel*. Raking up the soil to expose the pupæ and spraying poisoned molasses are effective in reducing both these pests. In addition, *Dacus correctus* flies can be attracted to *Clensel* and killed in numbers.

As a result of intensive collections three more fruit flies —*Sphenixomyia* sp., *Dacus persicæ* and *Euphrenta* sp. have been added to the list of South Indian Trypetidæ.

Virachola isocrates.—Studies of this pest of pomegranates were continued. The pest appeared in March-April and subsided by the end of June. The incidence of the caterpillar was very low at Coimbatore during the year. Control experiments have indicated that spraying of lead arsenate, crude oil emulsion and cutting away calyx cups have some effect in reducing the infestation. While the control trees showed an attack of 14 per cent the trees sprayed with lead arsenate showed only 4 per cent and those sprayed with Crude oil emulsion and those that had their calyx cups removed showed each 6 per cent.

The pest has been noted to breed in guava fruits and soapnuts (*Sapindus* sp.).

5. *Tobacco pests—Laphygma exigua*.—Investigations on this pest of tobacco nurseries at Chirala were continued. Ragi (*Eleusine coracana*) raised in long narrow strips on the edges of the tobacco plots was successful as a trap crop. The moths showed a preference to ragi for laying eggs. There was very heavy egglaying on the tender ragi seedlings which continued to be attractive for a period of five days from the date of germination. It was found by actual counts that ragi ceased to be attractive to the caterpillars 12 days after germination and the caterpillars showed a definite tendency to migrate into the tobacco beds. A systematic handpicking of eggmasses on ragi resulted in the removal of 28,87,960 eggs from an area of 54 acres. Handpicking of caterpillars which emerged from missed eggmasses on ragi and spraying of arsenical poisons against caterpillars which escaped to tobacco seedlings were also helpful in controlling the pest.

6. *Pests of chillies—The chillies thrips* (*Scirtothrips dorsalis*).—Sulphur and tobacco dusting trials were made to test the efficacy of each against the chillies thrips and how far each gave an economic return. The two treatments and the control were replicated six times. Each experimental plot was 1·91 cents. Three dustings were given in all but the two latter were rendered ineffective by rains that were received immediately after. From the toxic point of view both tobacco and salphur dust appeared equal but the former gave better yields than the latter. The experiment will be repeated to confirm the results of the trials.

7. *Coconut pests—The coconut beetle (Oryctes rhinoceros).*— Observations on the life history and bionomics of the pest under field conditions were continued and some additional information on the longevity and egglaying capacity of the beetles gathered. The beetle attack to the palms was noticed throughout the year and the maximum number of beetles were found in March-April. Control methods tried included (1) systematic hooking out and removal of beetles from palms and filling the holes with sand preventing further entry of beetle, and (2) use of the parasitic Green Muscardine fungus against beetle grubs. The trials so far made on the activity of the fungus in pots as well as in field pits have indicated, (1) that the fungus is able to fatally attack the larvæ and pupæ, (2) that the eggs are practically unaffected and are able to hatch out in the inoculated material, (3) the adult beetles too continue to thrive and lay eggs in the same but the young resulting grubs get affected, (4) under wetland conditions the attacked specimens were noted in the course of about 2 months but in the case of drier areas, the fungus was slow to show its activity in the pit.

Further trials are being made in other localities such as Taliparamba, Nileshwar and Aduthurai.

8. *Cholam pests—The earhead bug (Calocoris angustatus).*— Observations were made of the cholam earhead bug. Dusting of sulphur was tried as an experiment against the pest. There were in all six treatments, viz., (1) one dusting immediately after the emergence of the earhead, (2) one dusting on the 4th day after emergence, (3) one dusting 8th day after emergence, (4) same as 1 but with a second dusting with 6 days interval, (5) same as 2 but with a second dusting with 6 days interval, and (6) same as 3 but with a second dusting with 6 days interval. These together with the control were replicated four times. Each experimental plot measured 2 cents. The crop was sown on 25th March 1937 and harvested on 21st, 22nd June 1937. There were two counts of adults and nymphs for all the treatments. The pest incidence during the season was very light. Nevertheless the treatments on the 8th day after emergence of earheads gave constantly lower population counts and higher yields but the yield figures are not significant seeing that the pest incidence was light. On an average 40 lb. of dust were necessary for giving one round for an acre and the cost of the treatment including labour charges came to Rs. 5-4-0.

9. *Moringa pests——Stictodiplosis moringæ.*—This Cecidomyiad pest of moringa buds was studied in detail during the year. The female fly selects buds about 4 to 10 mm. long for oviposition. The maggots feed on the internal tissues and as a result of the attack the bud shrinks and ultimately drops down. The maggots come out and make cocoons of sand with a slight lining of silk and pupate inside them. The life cycle of the fly from egg to adult

is 12–19 days. Bordeaux mixture was tried as a repellent but did not show any good effect. Working up the soil underneath the tree to destroy the pupæ can be suggested as a method of control.

Noorda moringæ.—This is a major pest of moringa buds the incidence in some cases being as high as 78 per cent. The caterpillars first feed on the anthers and later the other contents of the bud. Only one caterpillar is found inside a bud. When the attacked buds drop down the caterpillars come out and enter the soil and pupate in light cocoons. The life cycle of the pest is about 24 to 28 days. As in the case of *Stictodiplosis moringæ* the soil underneath the trees can be raked up to destroy the pupæ.

10. *Cabbage pests—The diamond back moth* (*Plutella maculipennis*).—The life cycle of the pest under Coimbatore conditions is about 15–18 days. Dusting with pyrethrum powder was tried against the caterpillars and found to be effective. Detailed studies of the two parasites—*Brachymeria excarinata* and *Tetrastichus sokolowskii*—were made. The percentage of parasitisation of the host pupæ collected from the field is given below :—

	August. PER CENT.	September. PER CENT.	October. PER CENT.	November PER CENT.
Brachymeria	59·9	15·5	22·6	20·4
Tetrastichus	18·2	49·2	46·0	68·5

Of the two parasites mentioned above, Brachymeria attacks the pupæ and Tetrastichus the larvæ. The attacked larvæ however turn into pupæ the next day.

11. *Castor pests—The Castor mite* (*Tetranychus telarius*).—Life history studies of the mite were completed. Eggs are laid by the female mite on the under surface of the leaves. In 3–4 days the tiny larvæ come out and begin to feed on the leaves. After the first moult they become nymphs and after two more moults become adults. The complete life cycle occupies 10–12 days. The maximum longevity of a mite was noted to be 16 days and a female laid as many as 75 eggs. Dusting with flowers of sulphur and spraying with lime sulphur were tried as control measures. It was found that both dusting and spraying were effective against the mites, but the former was better as the larvæ which hatched out of the eggs already found at the time of dusting were also affected.

The Castor semilooper (*Achæa melicerta*).—There was a severe outbreak of this pest on castor in one of the Central Farm fields and advantage was taken of this to make observations on the different stages of the pest and its natural enemy—*Microplitis maculipennis* sz.

12. *Pests of stored products*.—Observations on the grain beetle —*Rizhopertha dominica*—were made during the year. Laboratory tests towards preservation of cholam from *Calandra* attack have

shown that grains mixed with Borax and copper carbonate prevent the entry of beetles while lime + Creostote, Copper carbonate and Sodium fluosilicate appear to check their multiplication.

Trials with cholam grains mixed with soapnut (Anacardium), Acorus rhizomes, leaves of Neem, Ocimum, Pongamia, etc., have been started to find out how far this treatment prevents insect attack. Acorus and neem leaves have so far given better results. Studies are in progress.

13. *Insecticidal trials—Toxic studies of tobacco stem infusions.*—Till now decoction was prepared from tobacco waste. Our studies during the year have shown that decoction can be prepared from tobacco stems and this even at dilution of 1 : 3 is effective against cotton aphis. The use of tobacco stems therefore reduces the insecticidal bill to a great extent. The results of the trials are given below :—

Strength of solution.	Percentage of mortality of aphis.			
	Cold infusion.	Boiled for 15 minutes.	Boiled for one hour.	Control (water).
Stock solution	99·11	98·1	100	..
1 : 1	76·6	92·6	100	7
1 : 2	100·0	74·4	85·3	..
1 : 3	95·5	26·2	97·4	..

The results of the analysis of the samples for nicotine contents received from the Government Agricultural Chemist are as follows :—

Cold infusion	0·0086	(grams in 100 c.c. solution).
Boiled for 15 minutes ..	0·0055	do.
Boiled for one hour ..	0·0070	do.

The following insecticides received from different firms were tried as time permitted :—

Keep Green, Floral, H.G. Ionised Insecticide, Lethalate Nicolate, Dry Pyrocide, Rubicide, N.N.K. Liquid, Liquid Tomino, Liquid Sulphur, Pyrethrum powder, Calcium and Lead arsenates, Emulsion Derrisol, 'Karpooravalli,' Multicide, Vesfume, Naaki and Extermite. Calcium arsenate and Lead arsenate mentioned above were received from a Japanese firm and the price quoted was 2 and 4 annas respectively per lb. as against the European stuff costing 12 annas and Rs. 1–8–0 respectively. Our trials have shown that these stomach poisons are as effective as those got from Europe.

14. *Chemotropic response of insects.*—A few field experiments were conducted during the year. Citronella oil, Vinegar, Kerosene, Benzaldebyde, Acetic acid, Lactose, Dextrose, etc., were exposed in glass dishes in Minnesota traps to note the attraction of insects to these chemical substances. The insects trapped were collected and are being studied. According to Dr. Imms in chemotropism we should seek for new and effective measures for combating insect enemies.

V. Life History Studies and Pest Control Work at Headquarters.

At the Insectary, in charge of the Assistant Entomologist, Mr. T. V. Subramaniam, the habits and life histories of various insects collected by the staff both at headquarters and outside while on tour were studied. Of the insects which received special attention, the following are the more important :—

1 The fruit fly—*Dacus correctus*—on sandal fruits.
2 The cotton jassids—*Empoasca devastens* and *E. formosana*.
3 The yam beetle—*Galerucida bicolor*.
4 The brinjal Sarrothripine—*Plotheia nephelotis*.
5 *Phyllium* sp. on guava.
6 *Saissetia nigrum* on cotton.
7 *Cirphis* sp. on grasses.
8 *Oryctes rhinoceros* on coconuts.
9 Spotted bollworms (*Earias fabia* and *E. insulana*) and *Tarache notabilis* on cotton.
10 Parasites of the white moth borer of cane (*Scirpophaga*).
11 *Achæa* on castor.
12 Tenebrionid beetle pest of wax.

Pest control work was attended to on the Central Farm and the breeding stations. The important pests which were treated were the citrus leaf miner; mealy bugs on guava; Epilachna on brinjals; scales on sapota; aphis on citrus, cowpea, cotton, mango; the castor semilooper; Papilio caterpillars on citrus; Aleurodids on pomegranates; Psyllids on curry leaf; mites on ragi; Aulacophora beetles on cucumber; and thrips on paddy.

VI. Bee-keeping.

Bee-keeping as a cottage industry is gaining rapid popularity. Numerous enquiries on the subject are being received from different parts of the Presidency and also from other provisions and States in India. Work in connexion with bee-keeping during the year showed considerable progress.

Apiary.—The Apiary at Coimbatore was the centre of attraction to numerous visitors interested in this industry. An average strength of about forty colonies was maintained throughout the year. The condition of the colonies was satisfactory in April and May due to favourable weather and pasturage conditions. But, with the advent of south-west monsoon and the following windy weather there was a decline in the colonies. The scanty showers received during September, October and November were, however, helpful in reviving the colonies. The subsequent droughty conditions and the resulting scarcity of pollen and nectar gave a set back to the activities of the bees till the end of the year. Generally speaking the season was not quite satisfactory for bee-keeping.

Research.—A new line of observations on the behaviour of bees in relation to weather and pasturage conditions was started in November. Some interesting information on the fluctuation in the activity of the bees, hourly and daily fluctuations in the weight of colonies under different conditions, influence of weather on the secretion of nectar in plants, time of visit of bees to different flowers, etc., was obtained. It is proposed to continue this study till next October. A Braconid parasite (*Apanteles galleriae*) was for the first time noted on the wax moths. The total life cycle of the wasp ranges from 16–22 days and the maximum longevity 27 days. Detailed studies on the parasite to see whether it is useful for the biological control of the wax moth are in progress. The study of the Tenebrionid beetle pest of wax received some attention. Attempts were made to adopt Demarree method of swarm prevention for the Indian bees but the pasturage and weather conditions were not conducive to such studies.

A report of what appears to be a disease of bees was for the first time received from Madras during August. In some respects the disease symptoms noticed were similar to those of ' Sacbrood ' prevalent in the West but there were also differences. The experts in foreign countries are being consulted in the matter. It is reported, however, that the colonies infested with the disease at Madras have subsequently recovered. In case the disease shows itself again detailed studies will be undertaken.

Propaganda.—Considerable propaganda work was done both by the Entomological section and district staff. Apicultural exhibits were sent to most of the important exhibitions and fairs in the Presidency. The usual short course in bee-keeping was held in February. Fifteen students in all—mostly sons of farmers—from various parts of the Presidency attended the course, and they were given a thorough training especially in the practical aspects of the subject. To give further stimulus for the spread of this cottage industry a " *Honey Week* " was organized by the section for the first time on a Presidency basis in April. Demonstrations in bee-keeping were given throughout the week in different centres of the Presidency. Bee colonies and apicultural appliances were on sale. A beekeeping exhibiton (*vide photo*) was arranged at the Apiary at Coimbatore and the Honey Week was inaugurated by the Principal on the 24th April 1937. The reports received from the district officers have shown that the Honey Week was a success and served the useful purpose for which it was organized.

VII. Eri Silkworm Rearing.

Rearing of Eri silkworms was continued throughout the year for supplying eggs to different rearers. As a result of enquiries in different parts of India it has been possible to find a market for Eri cocoons. Messrs. Haribux Lachminarayan, Fancy Bazaar, Gauhati, Assam, are willing to purchase pierced cocoons at the

rate of Rs. 60 per maund (82 lb.), Gauhati delivery. The freight charges from Coimbatore to Gauhati come to Rs. 9 by goods train.

VIII. Fumigation and quarantine work.

During the year, 75 lots including samples of seeds, live plants, cuttings, suckers, etc., were received from different parties. They were examined for pests, fumigated where necessary and pest free certificates issued. These included—

(1) Millets intended for despatch to Somaliland, Leningrad, Philippines, Nigeria, Sydney, Manila, Argentine, Warsaw and Ceylon and those received from Columbia, Texas, Sudan and Washington.

(2) Oil seeds intended for despatch to China, Washington, Japan and New York and those received from Uganda, Sudan, South Africa, Russia and Sydney.

(3) Paddy samples intended for London, Russia, Japan, China, Hungary, Ceylon, Nigeria, Kenya, Leningrad and Washington.

(4) Cotton seeds intended for despatch to China, Trinidad, London, Argentine and Ceylon and those received from Bombay, Egypt, Iraq, Uganda, Sudan, Brazil, China, Trinidad and Lyallpur.

(5) Miscellaneous items including potatos to Scotland; onion seeds to Suva, Fiji; banana suckers to Trinidad and Sydney; tobacco seeds to Chirala; grass seeds to Sydney; peppervine cuttings to New Guinea; and betel-vine rooted cuttings to Ceylon.

(6) Sugarcane setts were examined for the Government Sugarcane Expert and the Superintendent, Central Farm, for despatch to various places.

(7) Samples of tamarind intended for export to Egypt from Madras Port were examined from time to time by the Government Mycologist and myself and certificates issued. This is a new item of work.

(8) At the request of the Cotton Specialist his field laboratory was fumigated with Calcium cyanide.

IX. Systematic studies and collections.

Systematic work in Acarina, Coccidae, Braconidae, Chalcidae, Ichneumonidae, Pyralidae and Noctuidae showed considerable progress. A note on the more important of the Hymenopterous parasites collected recently is being prepared.

Eleven consignments of insects were sent for identification to the Imperial Institute of Entomology, London, of which seven were received back identified. In addition to those sent previously, four consignments were sent to the Bureau of Entomology, Washington, and eight were received back. One consignment of

Tingitids was sent to Professor Drake of Iowa. Our thanks are due to all these specialists. Besides these, several consignments of insects received from the Entomological Assistants in the districts were duly identified and sent back. Specimens of Leucospids and Xylocopas were sent to the Indian Museum for study by Mani and Tsincho Ma of China, respectively. Various insects were also sent to the Imperial Entomologist and the Director, Zoological Survey of India, on request.

The insect collections at Coimbatore are now thirty years old and contain some very valuable specimens of types and paratypes of South Indian insects and must be considered a national asset. It is very essential that provision should be made for the proper upkeep of collections and systematic work by reviving the retrenched post of the Systematic Assistant Entomologist.

X. Entomological work in the districts.

The Entomological Assistants stationed in the districts under circle officers attended to over 500 enquiries most of which referred to pest control. Observations on insect pests peculiar to the locality were also made as time permitted. They also did propaganda work in bee-keeping and were in charge of exhibitions and Pest Act operations.

In the I Circle the assistant stationed at Samalkot attended to numerous calls for help and advice and did a good deal of work in popularizing bee-keeping. He also made observations on the silver shoot disease of paddy, bark eating caterpillars on citrus, moth borers and Aleurodids on sugarcane, the stem borer of paddy and mealy bugs on coconut. The items taken up for demonstration included treatments for the red hairy caterpillar, *Laphygma* attacking ragi and onions, *Epilachna* on brinjals, tobacco plant lice, etc.

The more important pests which received attention in the II Circle were *Prodenia* and *Laphygma* on tobacco, Aleurodids on sugarcane, Aphids, borers and mites on cholam and citrus leaf miner. Observations were made on the grasshopper pest of cumbu—*Hieroglyphus nigrorepletus*—in Kanigiri taluk. The Assistant was in charge of Mycological work also during the year.

In the III Circle, the Entomology Assistant was in charge of Mycological work also. He attended to the following pests: fruit flies on ber, the jasmine bug, mites on figs, jasmine and citrus, Tingids on brinjals, Jassids on cotton, the cholam stem borer, the groundnut red hairy caterpillar, psyllids on curry leaf and grapevine flea beetle.

The major pests which received attention in the IV Circle were groundnut hairy caterpillar; coconut caterpillar; the swarming caterpillar of paddy; plant lice on tobacco and citrus; Pyrilla, Aleurodids and stem borers of cane; Epilachna and aphis on brinjal; Agathi weevil; and mango hopper. The Entomological

Demonstrator also did propaganda work in bee-keeping. Samples of tamarind intended for export to Egypt were examined from time to time for pests.

In the V Circle the more important of the reports of insect damage received and attended to during the year included the jasmine bug, Psyllids on citrus, *Tetroda* and *Spodoptera* on paddy, ' Surul ' on groundnut, *Laphygma* in ragi nurseries, *Utethesia* on Sunnhemp, *Hieroglyphus*, *Schoenobius* and *Ripersia* on paddy, the coconut beetle and weevil, tobacco aphis, etc. Demonstrations in beekeeping were given in different localities.

The Entomological Assistant in the VI Circle had his headquarters at Koilpatti shifted to Madura during the year. He attended to numerous pest enquiries which included chillies thrips, *Prodenia* on tobacco, pomegranate fruit borer, aphis on citrus, *Epilachna* on brinjals, the citrus caterpillar, grapevine flea beetle and lablab aphis and did propaganda work in beekeeping.

In the VII Circle the main pests attended to by the Entomological Assistant were the coconut caterpillar and the paddy swarming caterpillar, the coconut beetle, the mango hopper, thrips on chillies, Epilachna beetle, the coffee borer (*Xylotrechus*). Some time was spent by the assistant in popularising beekeeping.

The needs of the VIII Circle were attended to by the Entomological Section at Coimbatore and the more important of the enquiries are mentioned under " Enquiries and noteworthy pests of the year."

XI. Scientific papers prepared and published.

A. The following papers were published during the year :—

(1) " Practical hints on Beekeeping " by M. C. Cherian and S. Ramachandran, published in the Madras Agricultural Journal, May 1937.

(2) " Role of Insects in Rural Reconstruction " by M. C. Cherian, published in the Madras Agricultural Journal, October 1937.

(3) " Preliminary studies on the freckled yellow and stripe disease of cholam " by M. C. Cherian and M. S. Kylasam, published in the Proceedings of the Association of Economic Biologists, Volume IV.

(4) " Studies on *Elasmus zehntneri* Ferr, a parasite of the sugarcane white moth borer (*Scirpophaga*) " by M. C. Cherian and P. Israel, published in the Madras Agricultural Journal, September 1937.

(5) " A new Cecidomyiad pest of Moringa " by M. C. Cherian and Mohamed Basheer, published in the Madras Agricultural Journal, March 1938.

(6) " Studies on *Stenobracon nicevillei* Bingh a parasite of the sugarcane white moth borer (*Scirpophaga*) " by M. C. Cherian and P. Israel, published in the Bulletin of Entomological Research, London, March 1938.

B. The following papers were sent for publication :—

(1) " Mite (Acarina) pests of crops in South India and methods for their control " by M. C. Cherian, Agriculture and Livestock in India, Delhi.

(2) " Notes on the life history and habits of *Dacus brevistylus*—a pest of Coccinia indica frutis " by M. C. Cherian and C. V. Sundaram, Indian Journal of Agricultural Science, Delhi.

(3) " Studies on the white moth borer of cane (*Scirpophaga*) in South India " by M. C. Cherian and C. K. Subramaniam, Proceedings of the Association of Economic Biologists, Coimbatore.

(4) " Studies on *Brachymeria excarinata*—a pupal parasite of *Plutella maculipennis* " by M. C. Cherian and Mohamed Basheer, Proceedings of the Indian Academy of Sciences, Bangalore.

(5) " Short notes on *Metanastria hyrtaca* " by T. V. Subramaniam and K. P. Anantanarayanan, Journal of the Bombay Natural History Society, Bombay.

(6) " *Semiothisa* (*Macaria*) *pervolgata*—a Geometrid pest of Daincha (Sesbania aculeata) " by M. C. Cherian and B. Rangiah Pillai, Madras Agricultural Journal.

C. The following papers prepared during the year are awaiting publication :—

(1) " Studies on the coconut beetle (*Oryctes rhinoceros*) in South India " by M. C. Cherian and K. P. Anantanarayanan.

(2) " *Rhaconotus scirpophagae*—a parasite of the sugarcane white moth borer " by M. C. Cherian and P. Israel.

(3) " Notes on a Braconid parasite (*Apanteles galleriae*) of the wax moth " by M. C. Cherian and S. Ramachandran.

(4) " Studies on *Laphygma exigua* and its natural enemies " by M. C. Cherian and M. S. Kylasam.

Of these papers mentioned above, number 5 in A, 6 in B and 1–4 in C were presented at the Silver Jubilee session of the Indian Science Congress held at Calcutta in January 1938.

Besides these, various other items such as leaflets, articles for the Villagers' Calendar, research notes, a scheme for beekeeping for Chittoor, a note on the Entomology section for the Principal for publication in the ' Current Science,' Bangalore, a note on ' Insect pests and their control ' for the Manual of Gardening in

Jails and Schools in the Madras Presidency, and "Entomological Research in India, 1936," for the Society of Biological Chemists, India, were prepared during the year.

XII. Miscellaneous.

1. *Artists' section.*—The Artists' section continued to be under my charge throughout the year under report. The following items of work were attended to during the year :—Pen and ink drawings 298; Paintings 378; Labels 370; Photographs 456; Microphotographs 278; Prints 2,224; Lantern slides 827 and Poster enlargements 528.

Sri S. S. Subramania Ayyar and Sri M. Singara Royan were sent on tour to Koilpatti and Hosur, respectively, for painting and photographic work as desired by the Superintendents of the stations.

2. *Exhibitions and shows.*—Beekeeping appliances, colored posters, bromied enlargements, show cases of insects, etc., were supplied to the following exhibitions and shows for propaganda work :—

(i) Beekeeping Honey Week Exhibition in the section.

(ii) Agricultural and Industrial Exhibition at Karur.

(iii) Exhibition during the College Day and Conference of the College.

(iv) Sri Ramakrishna Vidyalaya Rural Reconstruction Centre Exhibition at Perianaickenpalayam.

(v) District Agricultural Exhibition, Cuddapah.

(vi) Car Festival and Exhibition, Karumathampatti.

(vii) Tiruvannamalai Deepam Festival, Tiruvannamalai.

(viii) All-India Swadeshi and Khadi Exhibition, Madras.

(ix) Srirangam Vaikunta Ekadeshi Exhibition, Trichy.

(x) Mahodayam Festival and Exhibition, Vedaranyam.

(xi) District Exhibitions, Salem.

(xii) Health Week Exhibition, Coimbatore.

(xiii) Mahasivarathri Festival, Erode and Kollegal.

(xiv) Exhibition at Mahanandhi, Kurnool.

(xv) Swadeshi Exhibition, Coimbatore.

3. *Special lectures.*—As desired by the Principal a lecture on "Some insect families of economic importance in South India" was delivered to the students of the I and II year B.Sc. classes. In the absence of the Assistant Lecturer in Entomology on other duty, assistant Sri K. P. Anantanarayanan helped the Lecturer in Entomology in conducting practical classes, for a month.

4. *University Examination in Agriculture.*—I acted as Examiner in Agricultural Zoology for 1938 as kindly permitted by Government.

5. *Entomological meeting at New Delhi.*—I attended a meeting of the Entomologists convened by the Imperial Council of Agricultural Research in November 1937 to discuss the sugarcane pests scheme. I also attended the meeting of the Advisory Board.

6. *Sectional meetings.*—Monthly meetings of the scientific staff of the section have been arranged from the beginning of the calendar year. Such meetings serve a useful purpose in bringing together the staff for discussion of various scientific problems tackled by them.

M. C. CHERIAN,
Government Entomologist.

Agricultural Research Institute,
Lawley Road P.O., Coimbatore,
May 1938.

DETAILED ADMINISTRATION REPORT OF THE GOVERNMENT MYCOLOGIST FOR THE YEAR 1937–38.

I was in charge of the Mycological section and the Microtome sub-section throughout the year. There was no change in staff.

The activities of the section are classified under the following main heads :—

(1) Mycological research.

(2) Virus disease investigations.

(3) Miscellaneous investigations.

(4) Propaganda and campaigns.

(5) Advisory work.

(6) Quarantine service.

I. Mycological research.

As usual, special attention was paid to diseases of major economic importance and to methods of controlling diseases in the field. The following are the main items of research.

1. *Paddy—' Blast '—Piricularia oryzæ—(a) Studies in disease resistance.* Six departmental strains, viz., Adt 10, Adt 2, Co 1, Co 4, Co 6 and G.E.B. 24 were inoculated with Piricularia through wounds on the leaf surface. Of these Co 4 and G.E.B. 24 are highly resistant under field conditions. All the varieties took infection and produced leaf lesions indicating that the resistance of certain varieties to Piricularia is not a case of physiological immunity.

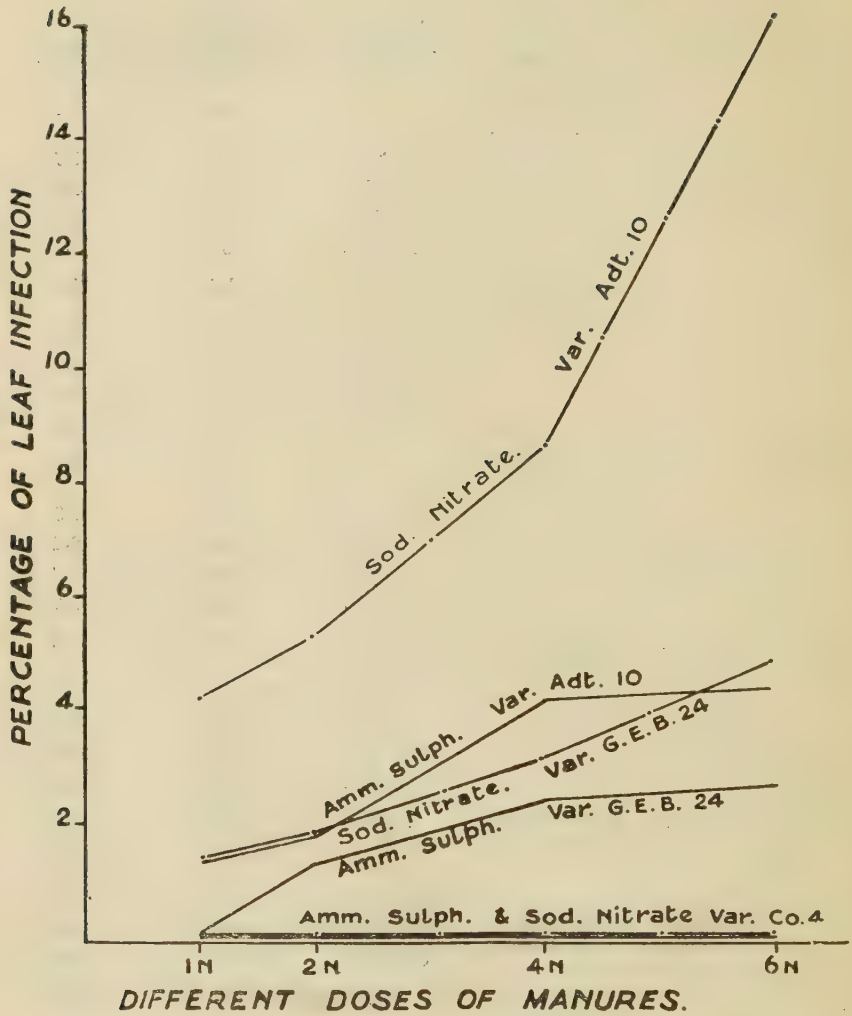
(*b*) *Factors affecting disease resistance.*—The pH values of the sap of two resistant and two susceptible varieties were determined. The results given below show that resistance is not correlated with differences in the pH of the sap.

Variety.	Susceptibility to Piricularia.	pH of sap.
G.E.B. 24	Resistant	6·74
Co 4	Do.	6·35
Adt 10	Susceptible	6·86
Mtu 5	Do.	6·86

(*c*) *Effect of Nitrogenous manures on the disease.*—A pot culture experiment was laid out to test the effect of varying quantities of nitrogen on the incidence of the disease. Three varieties of paddy were included in the trial. Nitrogen was applied as ammonium sulphate and sodium nitrate in units of 40 lb. of N per acre. The series consisted of four treatments, viz., 1 N, 2 N, 4 N and 6 N and each treatment was replicated five times. The

extent of disease was measured in relation to a chart prepared for the purpose. The following table and graph give the results :—

Variety.	Manure applied.	Dose (1 N = 40 lbs. N per acre).	Total number of leaves examined.	Amount of disease per leaf.
Adt 10	Ammonium sulphate.	1 N	66	1·4
		2 N	81	1·7
		4 N	173	4·1
		6 N	132	4·3
		Control.	62	2·2
Do.	Sodium nitrate.	1 N	36	4·2
		2 N	36	5·3
		4 N	34	8·7
		6 N	49	16·3
		Control.	40	4·5
G.E.B. 24	Ammonium sulphate.	1 N	40	0·1
		2 N	62	1·3
		4 N	50	2·4
		6 N	56	2·6
		Control.	42	1.5
Do.	Sodium nitrate.	1 N	40	1·4
		2 N	20	1·8
		4 N	29	3·1
		6 N	26	4·8
		Control.	21	2·0
Co 4	Ammonium sulphate.	1 N	40	nil.
		2 N	38	nil.
		4 N	37	nil.
		6 N	42	nil.
		Control.	39	nil.
Do.	Sodium nitrate.	1 N	56	0·04
		2 N	58	nil.
		4 N	83	0·01
		6 N	103	0·13
		Control.	44	nil.



The results indicate that increasing quantities of nitrogen applied as manure tend to increase the disease in susceptible varieties. For equal quantities of nitrogen, sodium nitrate induces greater susceptibility than ammonium sulphate. The variety Co 4 which is the most resistant in the series is unaffected by heavy doses of nitrogen.

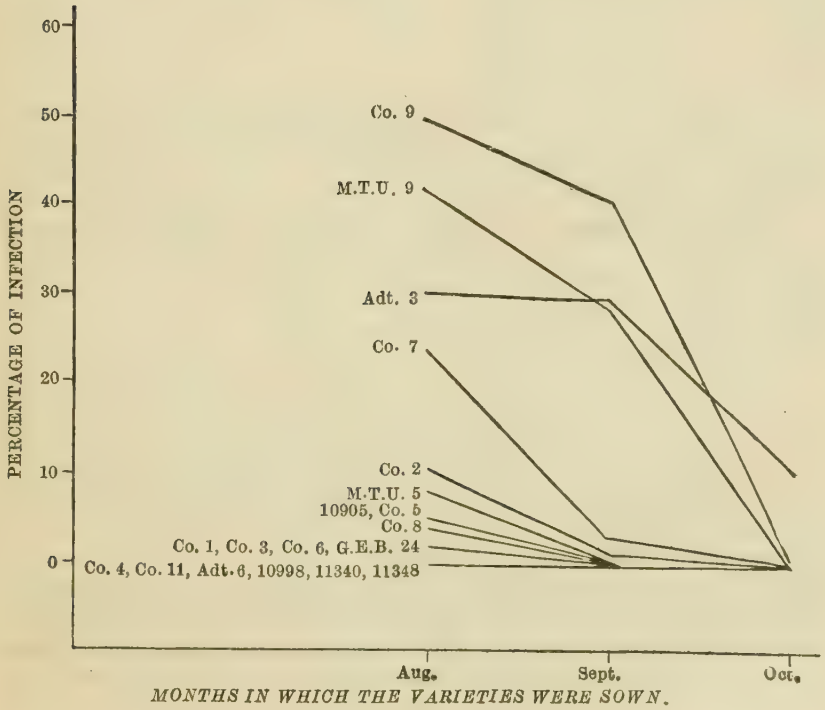
(*d*) *Effect of disease on yield in relation to period of sowing.*— Monthly sowings were done from August to December with 20 varieties of paddy which were sown in rows interstripped with *Korangu samba*, a highly susceptible variety. The dates of flowering were recorded and meteorological data for the whole period collected. Based on August sowings which gave the highest infection, the

ranking of these varieties in the order of their resistance is given below :—

Serial number.	Name of variety.	Order of susceptibility.	Percentage of infection (neck attack)
1	Co. 9	I	50·4
2	Mtu· 9	II	42·3
3	Adt. 3	III	30·1
4	Co. 7	IV	23·9
5	Co. 2	V	10·7
6	Mtu. 5	VI	7·6
7	10905	VII	5·4
8	Adt 2		5·3
9	Co 5	VIII	5·0
10	Co 8	IX	3·6
11	Co 1	X	2·0
12	Co 3		2·0
13	Co 6		2·0
14	G.E.B. 24	XI	1·6
15	11340	XII	0·4
16	11348		0·3
17	10998	XIII	Nil.
18	Co 11		Nil.
19	Adt 6		Nil.
20	Co 4		Nil.

Other observations made from this experiment are the following :—

(1) In August sowings the late-flowering varieties suffered less than the early flowering varieties. Varieties which flowered in October and November were more subject to disease than those which flowered in December and January (vide graph).



(2) In any one variety, the late sown crops suffered less than the earlier sown crops—possibly on account of the difference in the period of flowering.

(3) From a study of the weather data, this difference is attributable to more frequent rain fall, more cloudy days and increased relative humidity.

2. *Helminthosporiose of cereals—Helminthosporium spp.*—A comparative study of three isolations viz., from paddy, ragi and wheat was started during the year. The study of the morphology of the three strains shows that the differences in size and septation of the conidia as given in the following table warrant giving each fungus the status of a species.

Morphological differences in Helminthosporium spp. isolated from wheat, ragi and paddy.

	Wheat strain.		Paddy strain.		Ragi strain.	
	Mode.	Mean.	Mode.	Mean.	Mode.	Mean
Length of conidia in microns.	38·50	38·58	21·00	21.50	70·00	70·14
Breadth of conidia in microns.	10·50	11·55	10·50	6.95	12·25	11·65
Septation	5·00	4·5	4·0	3·85	9·00	9·12

Parasitism.—The results of inoculation experiments with the three strains are given in the following table :—

Fungus from.		Wheat.		Ragi.	
		Ears.	Leaf axils.	Nodes.	Leaf axils.
Wheat	Number inoculated ..	21	25	15	25
	Number infected ..	21	25	12	14
Ragi	Number inoculated ..	18	25	20	24
	Number infected ..	10	9	16	5
Paddy ..	Number inoculated ..	18	25	..	20
	Number infected ..	nil.	6	..	nil.

The results of seed infection experiments are given below. The seeds were soaked in spore suspensions of their respective strains of fungi and sown in germination trays.

Host and strain of fungus.	Number of seeds sown.	Number germinated.	Number of infected seedlings.	Percentage.
Wheat on wheat	75	75	63	84·0
Ragi on ragi	76	76	65	85·5
Paddy on paddy	75	72	57	79·0

These studies have shown that

(1) wheat leaves, nodes, leaf axils and ears are attacked by the wheat and ragi strains; (2) ragi leaves, nodes and leaf axils are attacked by wheat and ragi strains; and (3) the paddy strain was able to infect a few wheat leaves, but failed on wheat ear-heads and ragi leaves.

Physiological studies—(a) Growth rate.—In a comparative study of the rate of growth of the three strains, it was found that under identical conditions the rate was in the following descending order: Ragi, wheat, paddy. The optimum pH for growth was however found to vary slightly for each strain.

Growth rate of Helminthosporium spp.

Number.	pH value of medium.	Rate of linear growth per day. Ragi strain. m.m.	Wheat strain, m.m.	Paddy strain. m.m.
1	5.50	7·07	4.10	3·38
2	6.01	7·37	4.55	3.64
3	6·69	7·62	5·25	3·83
4	7·20	7.90	5.10	4·03
5	8.38	7.30	4·50	4·29

(*b*) *Saltation.*—An attempt was made to study the phenomenon of saltation which occurs in this class of fungi. Four saltants were obtained from the ragi strain.

(*c*) *Change in pH of liquid media.*—All the three fungi were grown in liquid cultures of various initial pH values. There was an initial drop in the values indicating the production of an acid but later the values rose gradually till they reached a more or less uniform alkaline range.

3. *Paddy ' foot-rot '—Fusarium moniliforme var. majus.*—Fifty-nine selections made by the Superintendent, Agricultural Research station, Maruter, from *Garikasannavari*, a variety of paddy grown in the Godavari delta, were tested for resistance to foot-rot.

The use of ' Ceresan ' as an efficient seed-dressing against seed-borne diseases like ' foot-rot ' is becoming popular among paddy growers. A prominent landlord in Coimbatore who treated seed for 10 acres of paddy has testified to the remarkable effect of the treatment on his crop.

4. *Paddy ' leaf-spot '—Nigrospora oryzæ.*—This fungus has been recorded on several occasions from samples of paddy plants received. Repeated inoculation experiments with the pure culture of the fungus conducted during different seasons and on several cereals including seven varieties of paddy gave only negative results. The fungus does not appear to be a parasite of any consequence.

5. *Red-gram ' wilt '—Fusarium vasinfectum.*—This disease has been noticed in a virulent form in Field No. 7 of the Cotton Breeding Station. Advantage was taken to study this disease both in the field and in the laboratory. The following observations were made during the year :—

(1) First infection can take place as early as 18 days after the emergence of the seedlings.

(2) The incidence of wilt steadily increases from the fifth week and reaches the peak point between the 13th and 15th weeks which synchronises with flowering and pod formation in the crop. Thereafter there is a decline up to the 21st week when the crop is ready for harvest.

(3) The soil temperature at the period of maximum infection ranges between 70° F and 80° F.

(4) The fungus runs up the dying stem up to about two-thirds of the height, but the pods are free and hence the disease is not seed-borne.

(5) Infected soil invariably gives rise to disease but sterilized soil does not.

(6) Under favourable conditions the perithecial stage is produced on dead roots in the soil.

Field trials on control of wilt.—Based on the analogy of the control of cotton root-rot (*Phymatotrichum omnivorum*) in the United States of America by the application of bulky organic manures, an experiment was laid out in Field No. 7 of the Cotton Breeding Station. Farm yard manure at the rate of 15 tons per acre and green manure (Sann-hemp) at the rate of 30 tons per acre were buried in trenches six weeks in advance of sowing and each treatment was replicated six times. Sowing was done in July and wilt incidence recorded week by week. Wilt incidence was very high ranging from 90 to 100 per cent. The analysis of the results shows that none of the treatments has any effect on the incidence of wilt.

Red-gram wilt—Percentage of deaths in different treatments (from showing to harvest).

Treatment	Replicates. (1)	(2)	(3)	(4)	(5)	(6)	Total (1) to (6).
A Green manure ..	85·94	87·18	99.15	98·24	99·13	95·28	564.92
B Cattle manure ..	100·00	92.15	97·57	100·00	100·00	93·7	583.09
C No manure ..	90·08	99·17	100·00	93·61	100·00	19·55	511·41
Total (A to C) ..	285·02	278.50	296·72	291·85	299.13	208.53	1659·42

Analysis of variance on data from above.

Source of variation.	Sum of squares.	Degrees of freedom.	Mean variance.
Treatments	506	2	253
Replicates	1983	5	396.6
Error	2093	10	209·3
Total ..	4,582	17	

$$F = \frac{\text{Treatment variance.}}{\text{Error variation.}} = \frac{253}{209{\cdot}3} = 1{\cdot}209$$

0·05 per cent point of F in Table 35 of Snecder (1934) with 10 degrees of freedom for the smaller mean square and 2 degrees of freedom for greater mean square is 4·1. Therefore the variations are not significant.

6. *Cotton wilt—F. vasinfectum.*—A comparative study of the cotton and red-gram wilt fungi showed that they are morphologically and physiologically different strains of the same species and cross inoculation experiments showed that the cotton strain does not infect red-gram and vice versa. Infection was found to be soil-borne.

7. *Chilliwilt—F. vasinfection.*—A third strain was recorded during the year on chilli plants in the Central Farm. The fungus caused considerable damage to the crop after it came into flower.

The fungus was isolated and further studies are in progress. Inoculations on young chilli plants have not been successful.

8. *Aeca palm—Mahali* (*Phytophthora areca*).—The study of of this disease which was taken up afresh last year was continued especially from the view point of the best method of control.

(*a*) *Over-wintering of the fungus.*—Attempts were made to grow the fungus on sterilized areca garden soil, soil extract, decomposed leaf mulch and leaf mulch extract. The fungus failed to establish itself on any of these media. This observation goes to show that the possibility of the fungus multiplying in the soil or the leaf mulch applied as a manure to the trees does not exist.

(*b*) *Field experiments on control.*—Extensive field experiments involving 16 different treatments were carried out in South Kanara. The experiments were designed to gain knowledge on several aspects of control especially the following :—

(1) The relative efficacy of single and double sprays.

(2) The relative advantage of 2 per cent and 1 per cent Bordeaux mixture.

(3) The relative merits of different 'stickers' and 'spreaders' added to Bordeaux mixture.

Weekly records of nut-fall were maintained throughout the period of the crop (about ten months) and fallen nuts were examined and classified as due to 'Mahali' and other causes. A summary of the analysis of the results is furnished in the following tables :—

Treatment effects on infection per plant in Vittal and Kandigai.

Treatment combinations.		Number of sprays.	Percentage infection per tree.	Unit of 10 plants in the mean.
Mixture used.	Adhesive per 100 gallons.			
Bordeaux mixture 1 per cent.	Resin soda (8 lbs + 4 lbs).	2	5·8*	2
	Casein (2 lbs)	2	2.5*	3
	Coconut oil (½ gallon) ..	2	0·7*	3
Do. 2 per cent.	Resin soda (8 lbs + 4 lbs)	2	5·4*	4
	Casein (2 lbs)	2	8·8	3
	Coconut oil (½ gallon) ..	2	2·9*	3
Do. 1 per cent.	Resin soda (8 lbs + 4 lbs).	1	32·0	4
	Casein (2 lbs)	1	12·5	3
	Coconut oil (½ gallon)	1	17·0	2
Do. 2 per cent.	Resin soda (8 lbs + 4 lbs.	1	6·3*	2
	Casein (2 lbs)	1	3·3*	3
	Coconut oil (½ gallon)	1	2·2*	1
Do. 2 per cent.	Fish oil resin soap (10 lbs) ..	2	7.0*	3
Cuprous oxide 1 per cent ..	Casein (2 lbs)	2	14·6	4
Bordeaux mixture 2 per cent.	Niger oil (½ gallon)	2	2·5*	3
Do.	Without adhesive	2	2.8*	3
Control	No spraying	34·9		3

* Effective treatments not significantly different from each other.

N.B.—For the double spraying series the first spraying was given between the 23rd and 30th May and the second spraying between the 23rd and 30th July 1937. For the single spraying series the spraying was given between the 3rd and 8th July 1937. The monsoon in 1937 was particularly late as it commenced only on the 10th June.

Analysis of Variance of treatment effects on mahali infection in Vittal and Kandigai experiments.

Variations due to	Degrees of freedom.	Sum of squares.	Mean square.
Between treatments..	16	5,26,99·89	3293·7
Remainder	28	2,31,72·36	..
Between plots ..	44	7,58,72·25	..
Within plots ..	445	13,63,75·39	306·48
Total ..	489	21,22,47·64	

P < 01. *Hence the treatment effects are significant.*

Main effects of treatment.		Infection per plant.	
Bordeaux mixture ..	1 per cent	13	Significant.
	2 per cent	5·1	
Adhesives	Resin	14·5	Significant.
	Casein	6·8	
	Oil	5.2	Not significant.
Number of sprayings..	Single	14·9	Significant.
	Double	4·3	

The following inferences are made from the above results :—

(1) The control (unsprayed) plots show the heaviest infection.

(2) Cuprous oxide is a poor substitute for Bordeaux mixture.

(3) Two sprays with Bordeaux mixture exercise better control than a single spray.

(4) Two per cent Bordeaux mixture is more efficacious than 1 per cent mixture.

(5) Vegetable oils and casein function as good spreaders with 2 per cent and 1 per cent strengths of Bordeaux mixture.

(6) Taking all the treatments altogether, oils and casein are better spreaders than resin.

(*c*) *Flight of spores.*—Aeroscope slides exposed throughout the season showed that resting conidia of the fungus are trapped throughout the year but sporangia are trapped only during the heavy monsoon months.

(*d*) *Physiological studies.*—The following points of scientific interest were revealed during the study of the fungus in the laboratory :—

(i) Unlike higher fungi which produce a mat of mycelium on the surface of liquid cultures, *P. arecæ* makes a submerged growth and this character persisted even when the original inoculum was floated on cork sheaves.

(ii) The fungus produces a quantity of oxalic acid sufficient to bring down the pH of liquid cultures from 5·0 to 3·64 from 6·0 to 4·15 and from 7·0 to 4·92 within the space of 14 to 18 days.

(iii) A crude extract from infected potato plugs showed the presence of the cell-wall dissolving enzyme 'Pectinase'.

9. *Glœosporium blight of arecanuts.*—A new disease affecting the inflorescences and nuts of areca was recorded last year. Though first recorded in South Kanara, the disease was found to be prevalent in parts of Coimbatore taluk. The disease is characterised by the following symptoms: Spots on the leaves, leaf sheath, peduncles and pedicels; shedding of flowers and tender nuts; partial drying up of bunches. Acervuli are profusely formed on the surface of tender nuts and stalks. Counts taken in two gardens at Semmedu showed 42 and 59 per cent infection of bunches. Inoculation experiments proved the fungus to be parasitic on tender areca and coconut inflorescences but a variety of known hosts of the genus failed to take infection.

A field experiment was started at Semmedu in January to try the effect of a protective spray on the disease. Preliminary trials showed that half per cent Bordeaux mixture has no deleterious effect even on newly opened inflorescences. Two hundred trees were selected at random and divided into four lots of 50 trees each and the following treatments were tried:—

(1) Half per cent Bordeaux mixture immediately after emergence.

(2) Half per cent Bordeaux mixture one week after emergence.

(3) Half per cent Bordeaux mixture three weeks after emergence.

(4) Control.

The results of this experiment are being recorded.

10. *Horsegram Wilt—Macrophomina phaseoli.*—Laboratory studies with the fungus were made on the following aspects:—

(1) Growth in relation to H-ion concentration.

(2) Shifts in pH in the nutrient media.

(3) Thermal death point of sclerotia.

(4) Saltation phenomenon.

(5) Toxicity of filtrates from fungus cultures.

(6) Biological antagonisms with Trichoderma.

(7) Pycnidial formation.

(1) The optimum pH. for the growth of the fungus as judged by plate cultures is 5·17 to 8·04 pH. The fungus tolerates a wide range of pH. from 3·04 to 7·97

(2) *The pH. in the nutrient media* shifts from acid to alkaline and vice versa to veer round a point near pH. 7, i.e., if the medium is alkaline it becomes less alkaline and if acid less acid.

(3) *Thermal death point of sclerotia.*—The thermal death point of sclerotia was determined by subjecting them to exposure to moist heat of different temperature for a period of 10 minutes The sclerotia were killed at temperatures beyond 56° C. The thermal death point would appear to be between 55° C to 56° C at 10 minutes, exposure.

(4) *Saltation.*—In a week old culture of the fungus in Waksman liquid medium (5·0 pH.) two forms of the fungus were noticed—(*a*) a form with fluffy ærial mycleium with few sclerotia and (*b*) a form with sparse growth of mycelium producing a large mass of sclerotia. The identity of the two forms was maintained in repeated sub-cultures and it would appear that the forms are saltants of the fungus.

(5) *Toxicity of the filtrate.*—From an experiment done during the year it would appear that the filtrate of the fungus does not exert any appreciable toxic effect on the host plant.

(6) *Biological antagonism—Trichoderma lignorum and Rhizoctonia bataticola.*—In a preliminary experiment it was found that the fungus *Trichoderma* exerts an inhibiting influence on the growth of *Rhizoctonia bataticola.* When grown together in Van Tieghem cells and observed under the microscope there were indications of the possibility of Trichoderma being parasitic on the other.

(7) *Pycnidia in culture.*—The pycnidial form was found to occur in cultures of the fungus grown on several solid media and Leonian's special pycnidial medium. So far this form has not been observed in cultures of the strains of the fungus from other hosts, e.g., cotton and groundnut.

11. *Citrus diseases.*—There were more enquiries and calls for technical advice on citrus diseases than on diseases of any other individual crop. This is indicative of the increased interest in orange culture in the province and a reflection on the paucity of knowledge among cultivators of the methods of dealing with citrus diseases.

(*a*) *Bark-rot and ' water injury ' in Kistna delta.*

A serious disease of the bitter-sweet variety *Citrus maderaspatana* Tanaka, was reported from villages round about Bezwada, Though not a commercial variety, the produce commands a good local market. The trees being prolific bearers, they are a sure source of income to growers. Trees which were in apparently good health bearing dark green foliage wilted away within the space of a week with the leaves and immature fruits drooping from them.

The growers attributed the trouble to the proximity of some tanneries to their gardens. But this belief proved unfounded since the disease was subsequently detected in gardens several miles away from tanneries.

An investigation of the trouble revealed the following facts :—

(1) On pulling away the soil from the trunk of dying trees, there was a complete ring of injured bark. Trees with a patch of healthy bark remained apparently healthy in spite of extensive injury on the side. The wood below the bark canker and some of the roots were stained black as a result of fungus invasion.

(2) The feeding roots were sparse and appeared sickly, the cortex sloughing off easily from the woody core.

Three fungi were isolated from dead trees, viz., *Diplodia sp.*, *Sporocybe hybrida* n. sp. Mason and *Haplosporella* (sub-genus *Pleospaeropsis*) *sp.* (The latter two were kindly identified by the Imperial Mycological Institute, Kew.) Of these *Diplodia sp.* which differs from *Diplodia natalensis*—a species recorded to be parasitic on citrus roots—is constantly associated with dead citrus trees. The other two are not recorded to be parasitic. *Diplodia* is recorded to attack roots depleted of carbohydrates. Since the ring of dead bark at the base of the trunk prevents the translocation of starch to the roots, the death of the trees is apparently caused by the attack of some weakly parasitic organisms.

A special study of the fungus *Diplodia sp.* was taken up and the following observations were made :—

(1) Contact and wound inoculations on roots of 2-year old seedlings of citrus were unsuccessful.

(2) The fungus grows in a pH range of 4·5 to 8·2. The optimum is in the region of 5·5 pH.

(3) The fungus does not grow in soil extract and in sterilized and unsterilized soil, grows sparsely in sterilized tannery waste water, but makes profuse growth on sterilized leaf mould and sterilized cattle manure. Among nutrient media, the best growth was on Waksman agar (5·26 pH).

(4) The fungus is not inhibited by *Trichoderma lignorum*; on the other hand *Trichoderma* was over-run by *Diplodia.*

(5) The optimum relative humidity for growth was between 85 to 90 per cent.

(6) The thermal death point lies between 55° and 57°C. at 10 minutes exposure

(7) In liquid cultures of various initial pH values, there was a gradual shift of reaction towards an alkaline range.

Sporocybe hybrida was found to grow best in an alkaline medium of pH 8·4.

Control measures.—The soil conditions and system of cultivation practised in the tract appeared to have a bearing on the disease. The soil is heavy and distinctly alkaline the reaction varying between pH 8·4 and 8·8 up to a depth of 12 feet. The water table at the beginning of the rainy season averaged 6·8 feet. The trees are irrigated at intervals of about 10 days by a system of flood irrigation which brings the irrigation water in contact with the trunk. Flooding also stifles aeration of roots in the clayey soil. Control measures which are designed to remedy these defects are being demonstrated with the aid of a special staff under the supervision of the Deputy Director of Agriculture. II Circle. The following are the treatments :—

(1) Digging out and destroying dead trees.
(2) Scraping of the cankered bark, excision of stained wood, disinfection of wounds and application of Bordeaux paste.
(3) Pruning of low-lying unproductive branches flush with the stem, up to about 5 feet from the ground.
(4) Burying manure in trenches away from the trunk as against dumping it close to the trunk.
(5) Change from flood irrigation to ring irrigation leaving a ring $2\frac{1}{2}$ to 3 feet away from the trunk.
(6) Pulling away clayey soil from the crown of roots and replacing it with sand.

The results of these demonstrations are reported to be satisfactory.

(*b*) *Citrus stump-rot of nursery stock—Diplodia* sp.—A case of severe loss to the budded nursery stock was reported from Panyam in Kurnool district. The roots and collar were attacked by a species of *Diplodia*. Here again, the pH of the soil was above 8·2. One distinguishing feature was that the budded plants die out only after lopping the stock just above the bud-union. Unlopped budded plants and inarched plants whose leaves continue to elaborate carbohydrates were however free from the root disease. It appears possible that the disease could be prevented by prolonging the function of the leaves by a system of ' half cut ' above the bud union. It is proposed to try out this method during the next budding season.

(*c*) *Citrus ' mottle leaf '*.—This disease which is attributed to zinc deficiency is found to a greater or less extent wherever oranges are grown. Spraying of a mixture of zinc sulphate and hydrated lime has been found to be efficacious and to revive trees to normal growth of foliage.

12. *Cardamom diseases*.—There were several reports on cardamom diseases. A visit to some plantations on the Anamalais showed that there were two main diseases. (1) A mosaic apparently of virus origin and characterized by mottling of the leaves and tender shoots. (2) A rhizome rot causing the death of clumps in patches.

(*a*) *Mosaic.*—Cardamom is usually propagated vegetatively by planting rhizomes and consequently the mosaic is propagated through infected rhizomes. The virus is not transmitted through true seed, and consequently one method of reducing infection is seed propagation. This does not, however, preclude the possibility of transmission from diseased to healthy plants through an undetermined insect vector. Like sugarcane mosaic, the most fruitful source of control appears in the systematic roguing of diseased stools and breeding for mosaic resistance.

(*b*) *Rhizome rot.*—A species of *Cephalosporium* was isolated from affected rhizomes. Inoculation experiments showed that the fungus causes a soft-rot of tender rhizomes. Further studies are continued.

(*c*) *Leaf spot—Cercospora sp.*—A leaf spot of seedlings was found in specimens from the Palni hills. The disease did not appear to be of serious consequence. Half per cent Bordeaux mixture is being tried as a control.

13. *Ginger ' soft-rot '—Pythium butleri.*—The ' soft-rot ' disease is a menace to the industry on the West Coast where the area under ginger is about 18,000 acres. No reliable methods of control measures are known. A detailed study of the disease was started. The following are the main findings :—

(1) Oospores of the fungus are detected on the scales of preserved seed rhizomes. Under certain conditions the fungus develops in storage and attacks rhizomes.

(2) The fungus can be obtained from ginger soils by growing wheat plants in infected soil and isolating the fungus from wheat seedlings (Vanterpool's method).

(3) Successful inoculation experiments were conducted on the following plants : Melon, pumpkin, cluster beans, cowpea, tobacco, brinjal (*S. melongena*), chilli (*C. annuum*), papaya, amaranthus, wheat and dioscorea. Cotton plants failed to take infection.

(4) Growth is obtained in Waksman's agar medium of pH values ranging from 4·0 to 8·13. There was no growth at pH 3·13.

Growth of P. butleri in Waksman's agar medium at 20° to 21°C.

pH value.	Mean of average growth per day. in mm.
3·13	nil
4·0	7·55
5·0	9·35
6·01	10·30
7·20	16·50
8·13	15·10

(5) The optimum temperature for growth was found to be near 30°C.

Growth at different temperatures in Waksman's agar.

Temperature.	Average rate of growth per day. mm.
30—31°C	17·1
25—26°C	16·2
20—21°C	12·4
15—16°C	5·95

(6) Growth was highest at 100 per cent relative humidity but only slightly less at 90 per cent and 75 per cent.

The fungus grows profusely on sterilized organic substances like groundnut cake and paddy husk, moderately on gingelly cake and cattle manure, and sparsely on bone meal. There was no growth on leaf mold.

Control measures.—Preliminary experiments with the fungicides on seed rhizomes showed that copper sulphate (2 and 1 per cent), formalin (2 and 1 per cent), Bordeaux mixture (2 and 1 per cent), mercuric chloride (0·1 and 0·2 per cent), Cheshunt compound (2 and 1 per cent), flowers of sulphur, ceresan (1 grm. per 15 lb.) and semesan (1 grm. per 15 lb.) did not affect germination. Copper acetate (2 and 1 per cent), however, produced poor germination. Pot and field experiments to test the efficacy of seed dressings will be laid out this season. The fungus belongs to a genus which is affected by the nitrogen-phosphate ratio of the soil and field experiments are being laid out to test the effect of altering this ratio.

II. Virus diseases.

Several virus diseases came under notice during the period under report. It has not been possible to do more than a cursory study of these, for the lack of an insect-proof glass house.

1. *Sugarcane—Mosaic—Varietal resistance trials.*—The annual field trials to estimate the relative resistance to mosaic were continued. Seventeen varieties of cane were included in the trial. In the check variety (Co. 213) the percentage of infection was 86 as against 70 last season. A consolidated statement showing the varieties tested during the last five seasons and percentages of secondary infection recorded is given below.

Sugarcane Mosaic—Varietal resistence trials, 1933–34 *to* 1937–38.

Serial number and varieties tested.	Number of years under trial from 1933.	Percentage of infection.				
		1933–34.	1934–35.	1935–36.	1936–37.	1937–38.
1 Co. 205 Pusa ..	5	Nil.	Nil.	Nil.	Nil.	Nil.
2 Co. 213	5	95·0	95·0	63·5	70·0	86.0
3 Co. 335	5	Nil.	Nil.	Nil.	Nil.	Nil.
4 Co. 360	5	73·0	81·5	55·4	56·0	67·0
5 Co. 361	5	70.0	55·5	53·4	40·0	78·0
6 Co. 355	4	..	Nil.	Nil.	Nil.	Nil.
7 P.O.J. 2878 ..	4	Nil.	Nil.	Nil.	Nil.	..
8 Co. 363	3	39·0	17·0	11·4	..	..
9 Co. 402	3	7·5	13·0	13·4	..	..
10 Co. 408	3	31·0	13·5	37·5	..	..
11 Co. 412	3	8·5	10·5	7·2	..	..
12 Co. 205	2	Nil.	Nil.	..	..	..
13 Co. 353	2	..	..	5·4	Nil.	..
14 Co. 354	2	..	55·0	55·0	..	..
15 Co. 407	2	..	..	..	8·0	37·0
16 Co. 411	2	..	4·0	1·9	..	..
17 Co. 413	2	..	4·0	Nil.	..	..
18 Col 417	2	..	49·0	43·5	..	..
19 Co. 419	2	..	43·0	43·6	..	..
20 Co. 434	2	..	..	..	Nil.	Nil.
21 Uba	2	..	..	..	Nil.	2·0
22 B. 3412	1	70·0	..	..	..	..
23 E. K. 28	1	85·5	..	..	..	..
24 Poovan	1	62·5	..	..	..	..
25 Vellai	1	79·5	..	.	..	..
26 Pundia	1	..	..	25·6	..	..
27 Co. 229	1	..	..	Nil.	..	..
28 Co. 313	1	..	..	63·4	..	..
29 Co. 326	1	..	..	Nil.	..	..
30 Co. 331	1	..	..	38·0	..	..
31 Co. 352	1	..	..	..	Nil.	..
32 Co. 356	1	..	..	Nil.	..	..
33 Co. 364	1	..	..	..	..	44·0
34 Co. 404	1	..	..	..	..	49·0
35 Co. 414	1	..	..	..	..	62·0
36 Co. 415	1	..	..	..	..	10·5
37 Co. 416	1	..	..	..	62·0	..
38 Co. 421	1	..	..	24·3	..	..
39 Co. 422	1	..	..	..	Nil.	..
40 Co. 423	1	..	..	..	70·0	..
41 Co 426	1	..	..	43·1	..	..
42 Co. 429	1	..	..	39·9	..	..
43 Co. 432	1	..	..	..	18·0	..
44 Co. 433	1	..	..	..	..	45·5
45 Co. 438	1	..	..	..	23·0	..
46 Co. 508	1	..	..	Nil.	..	..
47 Co. 511	1	..	..	..	..	Nil.
48 Co. 513	1	..	..	..	..	66·0
49 Co. 520	1	..	..	..	..	36·0

2. *Solanum melongena* (*little leaf and bunchy top*).—A disease affecting the brinjal plant was noticed during the year in the Central Farm. The disease is characterized by a reduction in the size of leaves, alteration of the shape and texture of leaves, shortening of nodes, the absence of flowers and sterility. The entire plant is changed in general appearance. The absence of any visible organism associated with the disease indicated the possibility of the disease being due to a virus. The disease was found to be not sap-transmissible, but was successfully transferred to

brinjal (*S. melongena*) and datura (*Datura fastuosa*). The first visible symptoms on the grafted plant are seen after an interval of 21 days. The older leaves of the grafted plant continue to be normal, while new growths assume the characteristic appearance of the disease. This is the first record of the disease in South India.

3. *Potato viruses*—(*a*) *Simple mosaic.*—The investigation of the virus diseases was continued. Inoculation experiments were done at Coimbatore and Nanjanad (Nilgiris) with a view to identifying the diseases. A mosaic disease producing mild mottling symptoms was found to be sap-transmissible to *Nicotiana glutinosa* from the variety Sharpe's Express.

(*b*) *Aucuba mosaic* (*Solanum virus 9 of Smith*).—Two cases of successful inoculation were obtained at Nanjanad with this virus from potato to potato.

4. *Tobacco viruses.*—A rapid survey of the tobacco areas in Coimbatore and Salem districts was made with a view to ascertaining the prevalence of diseases caused by viruses in the crop. The following diseases were noticed :—

(1) Mosaic, (2) Ring spot and (3) Leaf curl.

Transmission experiments carried out at Coimbatore indicate the possibility of the existence of a number of strains of mosaic. One strain of mosaic which produces mottling symptoms on tobacco and local lesions on *Nicotiana glutinosa* was studied in some detail. It was sap-transmissible to chilli, tobacco and *N. glutinosa* but sap inoculated *Datura fastuosa* plants did not show any visible symptoms.

The thermal death point was found to be in the range of 87–88°C at 10 minutes exposure. It was found viable after four months in dried material.

A leaf curl resembling Thung's ' Kroepeck ' was noticed during the year. The leaves are twisted with leafy outgrowths from the veins on the lower surface of the leaves. The disease was not sap transmissible, but grafting gave positive results, the grafted plants showing characteristic enation symptoms in 18 days.

III. Miscellaneous investigations.

1. *Cereal rusts.*—An assistant attached to the " Cereal rust investigation " scheme under the Imperial Council of Agricultural Research worked at Coimbatore throughout the year. He was engaged in studying the epidemiology of rusts in the hills and plains.

The study of incidence of rusts in the hills.—Rust survey carried out at different periods of the year on the Nilgiri, Palni and Shevaroy hills showed that rust infection is found throughout the year in the Nilgiris and the Palnis. In the Nilgiris, the black, brown and yellow rusts of wheat, the dwarf and yellow rusts of barley and the black rust of oats were found throughout the year.

In the Palnis only the brown rust of wheat is found all the year round. The ' prevalence ' and ' destructiveness ' of brown rust is higher in the Nilgiris than in the Palnis and consequently the former is a more important focus of infection.

Monthly sowings of wheat were made at Coimbatore with 11 varieties of wheat. The following observations were made from these plots :—

(1) The May sowings fail to establish themselves.

(2) Black rust was first observed on 10th September 1937 on the June sown crop, while brown rust was first noted on 28th September 1937 on the July and August sown crops. This period is coincident with the period of heavy infection on the first season crop in the Nilgiris.

(3) Though infection takes place from September onwards, the period of high infection is from December to February with the peak period in January.

2. *Cloves—' bark rot '—Ganoderma sp.*—A disease of clove trees characterized by the splitting and flaking of the bark was found in the Burliar gardens and in an adjoining plantation. Fructifications of the fungus appear on dead wood and branches. Pruning of dead branches, scraping of the bark and painting the wounds with Bordeaux paste were tried with success.

3. *Seed dressings and fumigants.*—The standard method of fumigation with formalin and potassium permanganate was found too drastic for tobacco seed as the treatment killed the seed. The use of ' Ceresan ' as a seed dressing at the rate of 1 gramme per pound of seed was found to be harmless to the seed even after a period of three months. Ceresan as a seed dressing was successfully tried on paddy, ragi, cotton, ginger and groundnut.

4. *Spreaders for Bordeaux mixture.*—Field experiments with arecanuts tried to gauge the relative merits of resin, vegetable oils and casein as spreaders added to Bordeaux mixture showed that casein and vegetable oils are better spreaders than resin. This confirms previous findings when a field test was conducted on grape vines.

5. *Unspecialized parasitism in fungi.*—The study of the shifts in pH of liquid culture media caused by *Corticium koleroga* and *Corticium salmonicolor* showed that unlike the case of *Sclerotium rolfsii*, the pH changes from an acid range towards a neutral range. These fungi do not produce any oxalic acid and their unspecialized parasitism is not attributable to the production of oxalic acid.

6. *Spraying machinery.*—Samples of several types of spraying machinery of foreign and indigenous manufacture were obtained and tested with the help of the Entomologist and Research Engineer. The information on their merits and flaws and suitability

for specific purposes was communicated to the makers and importers.

IV. Propaganda and campaigns.

Active participation was done in two important campaigns, viz., the "Mahali" campaign in South Kanara and the "bud-rot" campaign in South Malabar.

1. "*Mahali*" *campaign.*—The widespread disaster of 1936 paved the way for intensive departmental propaganda in the arecanut areas on South Kanara, under the direction of the Deputy Director of Agriculture, VII Circle. The special staff of two demonstrators and ten fieldmen assisted by thirty climbers scoured the areas well in advance of the monsoon and educated public opinion in favour of preventive measures. Over 200 demonstrations were held in various centres. A limited quantity of sprayers and chemicals was stocked for sale in departmental depots. Co-operative societies and private tradesmen were encouraged to supply the needs of growers in the matter of sprayers, chemicals and spreaders. Local manufacture of sprayers was encouraged, the workshops visited, their products tested and advice rendered on possible improvements. Samples of new and efficient models were imported and information on sources of supply and prices imparted to importers. These efforts were rewarded in a large measure by making the growers' needs available to them near at hand. But the full benefits of such propaganda can be achieved only when ways and means are devised to prevent profiteering in these materials and secondly when the materials could be sold on credit to the very poor cultivators on the security of their produce. Despite these limitations, it is gratifying to record that the special efforts bestowed by the department were crowned with a measure of success never attained before. The following statement is typical of the achievement made in the district :—

Centre.	Area under arecanut (acres)	Area sprayed. (acres)	Percentage of area sprayed.
Chikkadi	1,726	1,133	65·7
Puttur	702	597	85·0
Vittal	934	908	97·2
Bayar	1,502	1,492	99·3
Total ..	4,864	4,130	84·9

2. *Bud-rot of palms.*—The Agricultural Pests and Diseases Act of 1919 was extended for a period of one year in respect of the bud-rot disease of palmyra and coconut palms in Palghat, Walluvanad and Ponnani taluks of South Malabar. A sub-assistant in Mycology, a Mycology demonstrator and a special revenue inspector continued to be in charge of the special work. Hitherto the

village officials merely reported cases of disease within their jurisdiction in the form of a monthly statement. The special revenue inspector or the agricultural staff verified these returns before serving notices to palm-owners. There was an inevitable delay of several weeks and often a few months between the first report of the disease and the destruction of the dead palms. Thanks to the co-operation of the Sub-Collector, Palghat, an important change was made in the system. The village officials who are statutorily " inspecting officers " were authorized to issue notices themselves and to record such facts in their monthly returns. The revised system which has been adopted in Palghat and Ponnani taluks obviates the inordinate delay in issuing notices and has created a greater sense of responsibility among the village officials.

It is still an unfortunate experience that serious discrepancies are detected between the statements of some village officials and the number of infected trees actually detected during a subsequent inspection. The co-operation of the superior revenue authorities has been enlisted in order to root out this evil and I am glad to record the whole-hearted co-operation received from the Sub-Collector, Palghat, who has spared no pains to see that the provisions of the Act are strictly enforced.

The special staff undertook an intensive survey of the Walluvanad taluk. Numerous trees which were not listed by village officials were marked and action taken. The special staff attended the annual *jamabandi* camps of the Revenue department and conducted educative propaganda at these gatherings.

3. *Exhibitions, fairs, etc.*—The section participated in five exhibitions during the year. Exhibits and show-cases were prepared and supplied to district officers on request.

4. *Press propaganda.*—Two press notes entitled " Mahali disease of arecanuts—a warning to areca growers " and " Mahali disease—Success of departmental propaganda " were sent to you and published in the Madras dailies.

V. Advisory work.

One hundred and twenty specimens of plant diseases were received for examination and advice. Besides these, several enquiries relating to plant pathological problems were answered by correspondence.

VI. Quarantine service.

Forty-three consignments of seeds and plants meant for export from the province were examined or fumigated and samples from nine consignments of tamarind meant for export to Egypt were examined and phyto-sanitary certificates issued.

A system of examining export cargo at port towns in the province and of subsequent examination of representative samples and certification by the Mycologist and Entomologist at Coimbatore was introduced with a view to aid exporters of plant products

such as fruits, nuts, preserved and processed vegetables, etc. Literature on the quarantine laws of foreign countries is being collected in order to render advice to Indian exporters of plant products.

VII. Microtome section.

The section continued to render service to several workers both in the institute and in the districts. The following figures give an idea of the volume of work turned out during the year.

Materials received	632
Materials embedded	441
Number of blocks cut	298
Number of slides prepared	1,592
Number of slides stained and mounted ...	1,191

Dr. P. J. Gregory, Research Fellow of the Madras University, and Mr. K. T. Jacob, special student, worked in the section for ten and two months respectively.

VIII. Miscellaneous.

1. *Special lecture.*—I delivered a special lecture on ' Diseases of plants caused by mineral deficiencies ' to the III-year B.Sc. students of the College.

2. *Scientific papers.*—A paper entitled " The relative functions of pectinase and oxalic acid in the parasitism of fungi " was read before the Association of Economic Biologists.

3. *Aid to scientific workers.*—Two fungi isolated by the lecturer in animal pathology, Veterinary College, Madras, were identified. Specimens and cultures of *Alternaria palandui* were supplied to Dr. Ohlsens, Copenhagen. Herbarium specimens of *Uromyces sp.* on *Mimusops elengi* were supplied to the Imperial Mycologist, New Delhi. Reprints of scientific publications were supplied to several overseas workers.

4. *Acknowledgments.*—I acknowledge my indebtedness to the Director and Mycologist of the Imperial Mycological Institute, Kew, for their ready help in the identification of specimens and cultures. To Dr. Fawcett and his colleagues at the Citrus Experimental Station, Riverside, California, and to Dr. Reichert of Tel Aviv, Palestine, I am grateful for their opinion on the pithy orange fruits occurring in Cuddapah district. My thanks are due to my colleagues at the Research Institute and to the District officers for their willing assistance and for facilities in the conduct of field experiments.

Agricultural Research Institute,
Coimbatore, *2nd May* 1938.

K. M. Thomas,
Government Mycologist.